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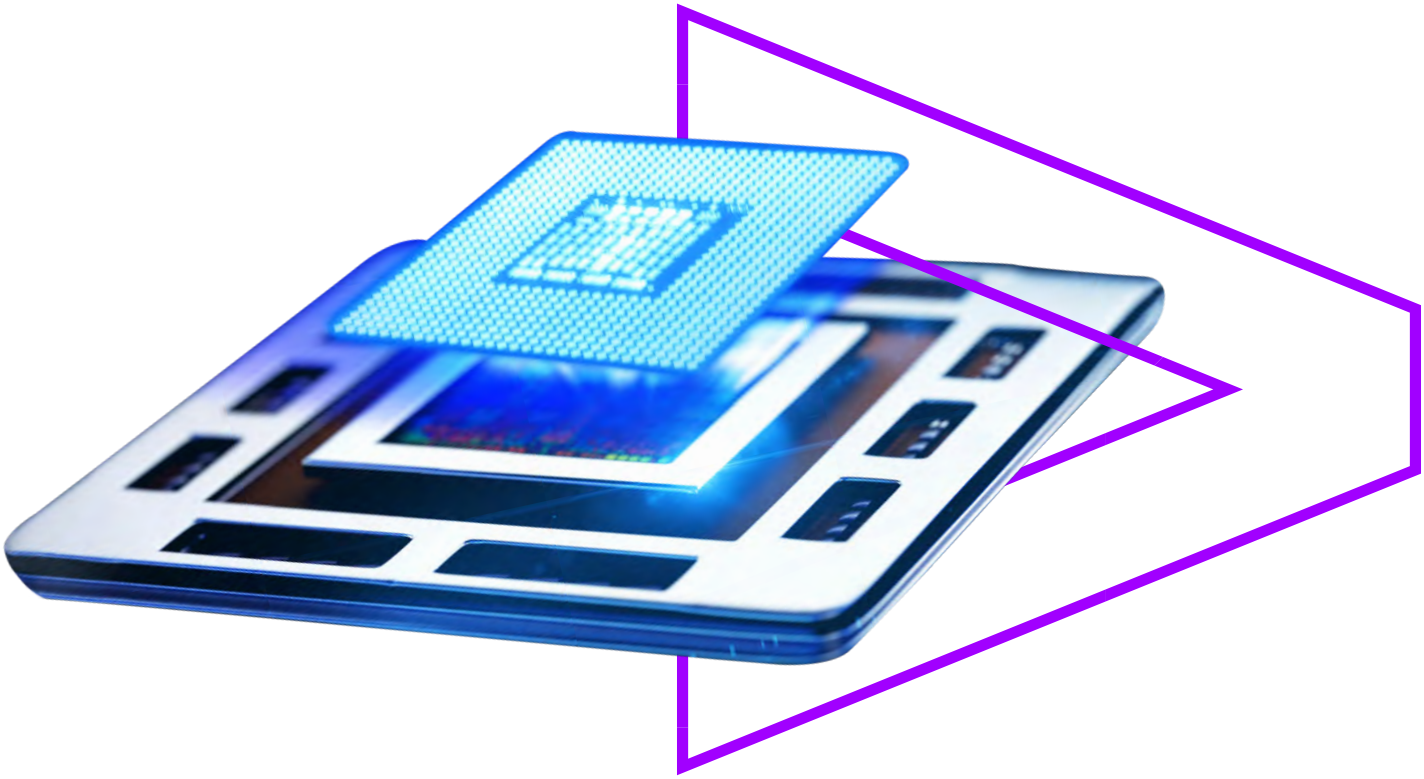

SEMICONDUCTORS

Fueling the Tech Industry's Future as Never Before

There's never been a better time to be a semiconductor company.

A spate of emerging technologies—especially, artificial intelligence (AI), augmented reality (AR) and extended reality (XR), and blockchain—are gaining prominence across industries as more and more companies find new ways to use them to create compelling new products and to transform their businesses. And at the heart of all of these technologies are the chips that make them work. In fact, more than ever, the entire tech world is depending on the semiconductor industry to step up to the plate and provide the computing power necessary for all these technologies to fulfill their potential. That spells huge growth potential for the semiconductor industry.

Semiconductor companies' enviable position is reflected in the most recent Accenture Technology Vision research, which annually explores the technology trends that will have the biggest impacts on the world and the resulting implications for organizations and the executives who lead them.

The **2018 edition of the Technology Vision**, based on a year-long research effort that included surveys of nearly 6,400 executives around the world, resulted in this year's thought-provoking report: "Intelligent Enterprise Unleashed: Redefine your company based on the company you keep." In it, we forecast the widespread opportunities available to companies to use technology at each level of the enterprise to improve performance and move closer to the center of people's lives.

Our research found the semiconductor sector occupies a unique space in regard to the technology trends we've identified. As producers of the chips that power the technologies that are driving change, semiconductor companies will see a tremendous boost in demand for their own products—thus driving more robust growth as these technologies become more pervasive. But additionally, like their counterparts in other industries, semiconductor companies will find that these trends open up new ways for them to use technologies to reshape their business strategies and operations.

In this report, we take a look at the five big trends our research uncovered for 2018 and their implications for semiconductor companies. We also discuss some key actions semiconductor companies should consider taking to begin capitalizing on the opportunities these trends create—both to increase sales and improve business performance.

THE FIVE KEY TRENDS FOR 2018

By embedding themselves throughout society, companies are blurring the lines between business and personal—and blazing a new trail for their own future growth. Technology is now firmly entrenched in our everyday activities, but its reach is larger than that: it's reshaping pieces of our society. This year's five Accenture Technology Vision trends highlight the rapid advancements in technologies that, in turn, are improving the ways people work and live.

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Citizen AI

Raising AI to Benefit Business and Society

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Data Veracity

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01

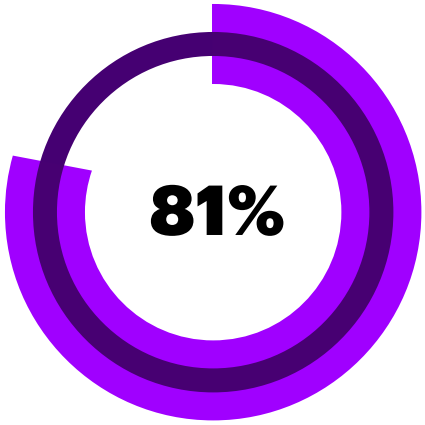
Citizen AI:

Raising AI to Benefit Business and Society

Artificial Intelligence's reach is growing throughout society. In fact, 90% of semiconductor executives in our research believe every human will be directly impacted on a daily basis by an AI-based decision within the next three years. Thus, any business looking to capitalize on AI's potential must also acknowledge its impact.

AI is different from conventional software and must be treated as such. AI can learn and make autonomous decisions and continuously evolve. Rather than being programmed to take specific actions, an AI solution "learns" from examining samples of input data and desired results—and then creates a new algorithmic model that can handle new, incoming data that needs to be processed.

AI's massive power means deploying AI is no longer just about training to perform a given task. Rather, companies need to "raise" it to act as a responsible representative of the business and a contributing member of society—taught to make unbiased decisions and represent an enterprise's core values. They'll also need to face the potential societal and liability issues that will require them to explain their AI-based actions and decisions—something eight in 10 semiconductor executives don't believe organizations currently are prepared to do.



of semiconductor executives agree organizations are not prepared to face the societal and liability issues that will require them to explain their AI-based actions and decisions, should issues arise.

of semiconductor executives believe every human will be directly impacted on a daily basis by an AI-based decision within the next three years.

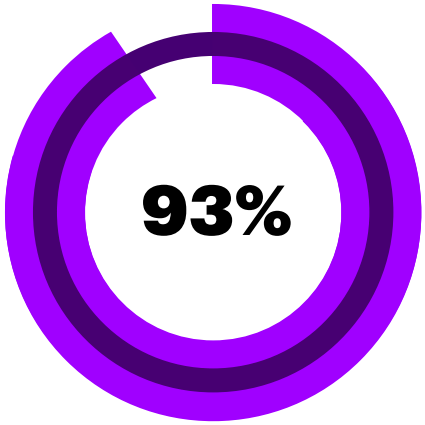
02

Extended Reality:

The End of Distance

The power of extended reality (ER)—which includes augmented reality (AR) and virtual reality (VR)—allows machines to operate at the cognitive level as humans and allows us to interact naturally with technology. This, in turn, reduces the distance between people and access to information and delivers fully immersive experiences.

Accenture believes ER introduces a whole new level of human potential into the equation, and it's going to empower humans to experience technology more effectively and to be much more efficient. Semiconductor executives in our research are similarly optimistic: 90% of them believe ER will create a new foundation for interaction, communication, and information. And the technology will eventually be pervasive: 93 percent think ER will be widespread and impact virtually every industry.



of semiconductor executives believe that ER will be widespread and impact virtually every industry in the next 5 years.

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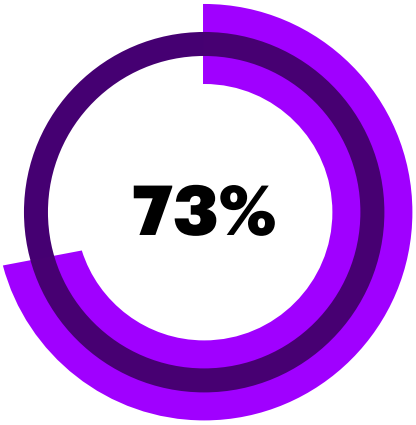
03

Data Veracity:

The Importance of Trust

As businesses invest in technologies with intensive data demands (such as AI and edge computing), ensuring data veracity—the truthfulness of the data driving decisions—becomes critically important. In fact, more than eight in 10 semiconductor executives said the importance of data integrity will grow exponentially as organizations rely on data-driven decisions. But 73% of semiconductor executives believe that many companies have not yet invested in the capabilities to verify the truth within the data used in their most critical systems. And that could mean trouble down the road.

The fact is, unverified, inaccurate or manipulated information threatens to compromise the insights that companies rely on to plan, operate, and grow. Left unchecked, with autonomous data-driven decision making increasing across industries, the potential harm from bad data becomes an enterprise level existential treat. Semiconductor companies are particularly vulnerable: 90% of them in our research are boosting their use of data to drive and automate decision making, which represents increased risk if data veracity doesn't receive proper attention.



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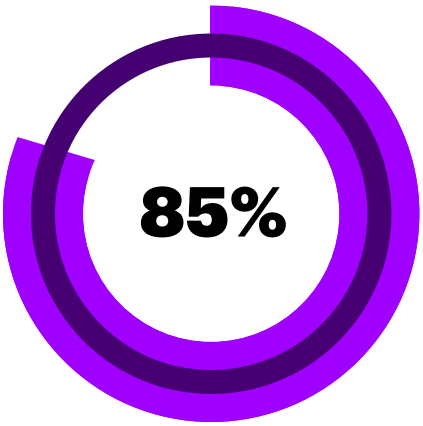


of semiconductor executives believe the issues of data integrity will grow exponentially as organizations rely on data-driven decisions.

04 Frictionless Business:

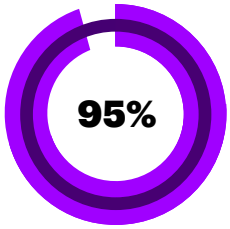
Built to Partner at Scale

Technology-based collaborations are developing at an unprecedented scale, pushing companies to be more integrated than ever before. However, legacy business systems weren't built to support this kind of expansion and, in fact, outdated systems are already hindering growth. Semiconductor executives see the challenge that's unfolding: 93% of them believe the strength and impact of ecosystem relationships will rest on how well an organization's technology can support these vital partnerships. Two technologies offer solutions to the challenge.

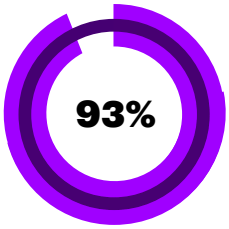
Microservices are one of these technologies. They are an approach to architecture that uses a suite of tools such as application programming interfaces (APIs), containers, and cloud to break applications into simple, discrete services. A microservices architecture provides a foundation for companies to forge relationships quickly and easily, seamlessly integrating services, without hindering partners or customers.

The other is blockchain, which is a distributed ledger system that stores groups of transactions (the "blocks") and then links and sequences the list of transactions using cryptography (the "chain"). Because blockchain transactions are inherently secure, verifiable, and unalterable, they're a great way for collaborators to communicate and interact with each other. That's important for semiconductor executives, 95% of whom said it's critical for their companies to be able to easily exchange data with other companies.

Blockchain's contribution could be significant. In the semiconductor industry, the investments involved in R&D and the competitive differentiation that intellectual property represents make the ecosystem wary of sharing data openly. Blockchain cryptography can increase the trust across members of the value chain and lead to greater standardization of data and data-collection methods. This, in turn, can provide the mechanism necessary to monetize the extremely data the ecosystem generates, thus opening up new revenue streams for participants.



of semiconductor executives agree that it is critical to easily exchange data with partners.



of semiconductor executives believe the strength and impact of ecosystem relationships will rest on how well an organization's technology can support partnerships.

05

Internet of Thinking:

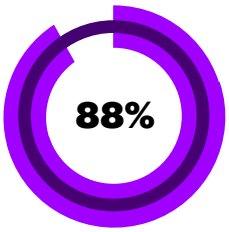
Creating Intelligent Distributed Systems

Robotics, immersive reality, artificial intelligence and connected devices are bringing a new level of technological sophistication to the physical world. Additionally, the number of IoT devices deployed is exploding along with the amount of data they subsequently generate. Current predictions suggest that by 2020, smart sensors and other IoT devices will generate at least 507.5 zettabytes of data (more than 500 billion terabytes).[1]

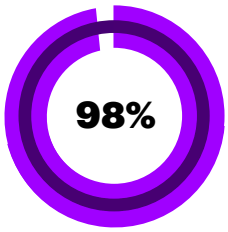
But many businesses assume their existing technical infrastructures will support the computing these systems require—and do so at their peril. Enabling intelligence for the next generation of technology demands an overhaul of existing infrastructures, with a balance of cloud and edge computing, and a renewed focus on hardware to deliver intelligence everywhere.

The automotive industry, a key growth market for semiconductor companies, is a good example. To prevent an accident, should automotive data go to a cloud for analysis then get sent back to the car, or should technology within the car itself analyze it? And how does a car's lifespan affect the requirements for the edge processing components themselves? There's a big difference between a sensor built to monitor equipment in a manufacturing site with a five-year depreciation window versus a sensor in a fast-moving car that will likely operate for 15 to 20 years.

Semiconductor executives are aware of the need for more processing power where data is generated: 88% said creating real-time insights from the volumes of data expected in the future will require computing at the edge. But they also recognize that striking the right balance between edge and cloud computing is key: Virtually all semiconductor executives (98%)—the highest among all industries—believe enterprises must have this balance to maximize technology infrastructure agility and enable intelligence everywhere.



of semiconductor executives believe that generating real time insights from the volumes of data expected in the future will require computing at the edge, where data is generated.



of semiconductor executives believe that enterprises must balance cloud and edge computing to maximize technology infrastructure agility and intelligent everywhere.

Product Portfolio Implications

These trends create significant growth opportunities for semiconductor companies, as all of them involve technologies that require chips. In fact, collectively, these trends represent billions of dollars in potential new revenue within the next few years for semiconductor companies with products that can respond to the growing need for more processing power driven by the technologies involved.

For example, in the case of AI, chips need immense computing power for deep learning and, hence, create the need for strong processors. AI chips also need a large amount of non-volatile memory to accumulate the data. That's driving demand for 3D NAND. The computing complexity of AI chips is also driving manufacturing innovations. Instead of smaller chips required by PCs and smartphones, AI chips are larger in size. That could drive capital spending and create an opportunity for semiconductor manufacturing equipment suppliers as well. And AI will boost the value derived from many new technologies when used in combination, which will open new market opportunities for the semiconductor industry. Overall, the AI chip market is expected to grow six-fold from roughly $6 billion in 2016 to $35 billion by 2021.[2]

Extended Reality also will generate enormous demand for high-performance computing applications, which in turn will drive wafer shipments and revenue for the semiconductor industry. Spending on AR/VR is expected to top $143 billion in 2020, more than half of which will be on hardware.[3] In fact, more than 90% of semiconductor executives in our research—the highest of any sector we studied—believe Extended Reality will be widespread and impact virtually every industry over the next five years.

As more technology-based partnerships emerge, required compute power needs will increase by factors in the hundreds, which will boost the demand for chips. For instance, in blockchain, the most important hardware components for mining are memory chips, graphics cards, and processors—all of which use vast quantities of semiconductors. The demand is such that some semiconductor manufacturers are developing cryptocurrency-specific graphic chips.

Finally, the proliferation of IoT devices means far more data will be generated than traditional centralized processing systems will be able to handle. Thus, enterprises will increasingly look to bring more processing power out of the cloud and to the edge of an IT system to be analyzed more quickly for faster decisions. And that's good news for chip makers with edge computing products in their portfolio. In fact, the portion of total spending on the IoT across all markets that involves semiconductor products or services will jump dramatically in the next several years from $15 billion in 2016 to $62 billion in 2025.[4]

Clearly, there's a lot of new money—tens of billions of dollars—to be made by semiconductor companies as these trends unfold across three waves that are typical for new technologies or applications:

Wave 1:

Use of existing solutions that are passable but not ideally suited for the application (such as employing graphical processors for machine learning or blockchain)

Wave 2:

Creation of tailor-made, application-specific processors

Wave 3:

Commoditization (software-defined architecture)

All of this year's trends are primarily still in Wave 1 and approaching Wave 2. To capitalize on this momentum, semiconductor companies should determine how they can use agile techniques (and fail fast inexpensively) to develop relevant new offerings, as the market may be willing to pay a premium for them in this phase before they become commodities. They also should consider pivoting to a solutions-or-systems-based offering (instead of allowing other companies to build it). For example, a graphics processing unit (GPU) that enables blockchain would be in demand, but a blockchain-specific GPU built as a system, with software offerings, would generate much more value.

Importantly, semiconductor companies should holistically evaluate their entire technology roadmap to ensure they're gaining scale when pursuing any of these areas. For example, AI and ER, at their core, drive similar computing needs and requirements. So a company should structure its organization to leverage those technologies as much as possible, differentiating in its R&D and other investments as late in the development cycle as possible.

As they work to develop new offerings, semiconductor companies should keep two things in mind. First, they need to increase the alignment between operations and strategy by boosting transparency within the company and across the ecosystem. Too often, shadow organizations within the company end up pursuing parallel large-scale efforts. Second, it's critical to empower marketing to incorporate the voice of the customer in the development of new solutions instead of allowing existing cash cows to determine which product features get baked into new offerings.

Operational Improvement Potential

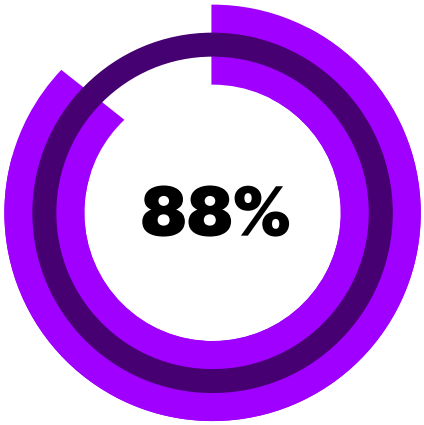
Semiconductor companies also need to think about how they can apply some of these new technologies to improve their own business.

For example, a big opportunity lies in data veracity which, in the semiconductor industry, is tightly linked to the frictionless business trend and blockchain. Given how strongly

networked the semiconductor industry is (across design, manufacturing, equipment, and logistics), a substantial amount of data is exchanged across many ecosystem partners in varying formats that needs vast amounts of interpretation and translation. But there's still no "standard" way of storing data. Furthermore, with so many of their activities outsourced to third parties, and with design and process complexity rising, semiconductor companies can find confirming the quality of their data and validating the sources of that data to be major challenges.

That's where blockchain can really shine, and it's why semiconductor companies are looking seriously at how it would work in their business. In fact, 88 percent of semiconductor respondents in our survey believe blockchain will be integrated in their organization's systems by 2021, and more than half expect to be investing in blockchain in the next year. Blockchain will promote far greater data sharing up and down the value chain with a high degree of access control, which will help the ecosystem securely avoid walled gardens and enable individual players to focus more on their core competencies. It also can serve as the standard for collecting and storing vital supply chain "track and trace" data, which is especially critical in the semiconductor industry, and can provide a secure way for ecosystem players to turn valuable data into additional revenue.

There's also a significant role for AI in semiconductor companies' business. AI could help optimize many operations, from supply chain management and technology spending to test time analysis, yield optimization, and defective parts per million (DPPM) prediction. But because of the sheer complexity of a semiconductor company's business and the advanced skills required, relevant AI offerings have yet to emerge for many of these areas.



of semiconductor executives agree that blockchain will be integrated into their organization's systems within 3 years.

AI capabilities eventually will emerge to handle such things as load management, testing, and design optimization, and semiconductor companies should continue to monitor vendors' progress. In the meantime, they also should explore how they could use AI in other areas of the business—such as the supply chain, procurement, and finance—for which advanced AI capabilities now exist.

The point for all of the technologies we've discussed is this: If a semiconductor company is developing products for applications that capitalize on an emerging trend for its customers, it should also be working with the ecosystem at large to prototype and deploy the same applications to improve its own operations.

TIME TO CATCH THE WAVE

Given their position in the high-tech world, semiconductor companies are acutely aware of how fast technology changes and how technology advancements can disrupt enterprises and entire markets. Accenture's Technology Vision provides a window into what semiconductor companies—and their customers and ecosystem partners—can expect in the next few years, as well as some perspective on what these trends could mean for their business.

To be sure, an explosion in processing-intensive technologies such as blockchain, AI, and ER will mean significant new revenue potential for semiconductor companies—particularly those that can move quickly to meet burgeoning demand at a premium price. In other words, now's the time for semiconductor companies to determine how to reshape their product portfolio to become the supplier of choice for these technologies.

It's also a good time for semiconductor companies to take their customers' lead and start mapping out the potential these trends have to dramatically improve the operations and performance of their own business. Plenty of use cases already exist and more will emerge as the technologies mature and companies continue to experiment.

There's never been a time when the semiconductor industry was better positioned for growth. Semiconductor companies will be the engine, the lifeblood, of the future world of technology. Who will step up to provide the faster, more powerful chips that are key to these technologies' fulfilling their potential?

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