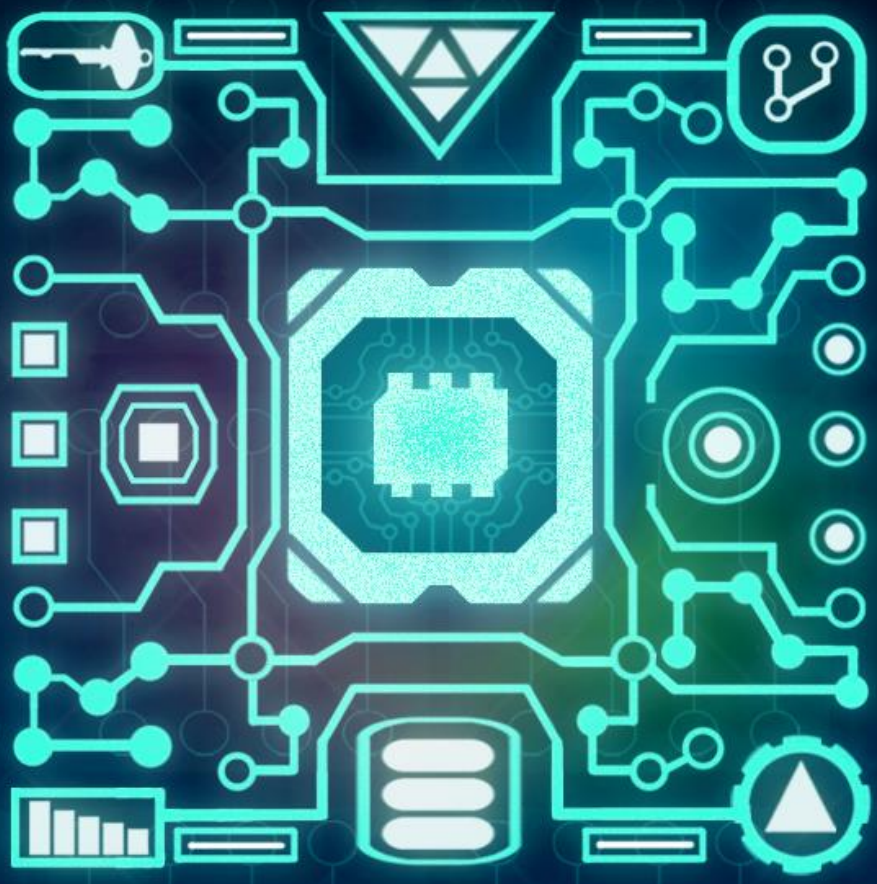
EqualOcean



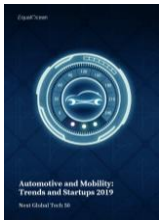
Semiconductors: Trends and Startups 2019

Next Global Tech 50

Welcome to the Global Startup Scene Overview 2019

EqualOcean has prepared a series of research reports on the new generation of private businesses across several sectors around the globe. Our coverage includes 11 industries that have been affected the most by cutting-edge technology and are likely to shape the international economic landscape of tomorrow. This series is to be presented during the World Innovators Meet 2019, an annual event that gathers global leaders from a variety of fields at the heart of Beijing.

Artificial Intelligence



Automotive and Mobility

Consumer Technology

Educational Technology

Enterprise Services

Financial Technology

Health Technology

Retail Technology

Smart Home Technology

Smart Manufacturing

Contents

Introduction

Nearly everything that has been described as a 'state-of-the-art technology' over the last four decades fundamentally relies on microelectronics. However, chipmakers – originators and facilitators of the 'transistor magic,' and possessors of notoriously tight margins – had long been living in the shadow of the global software titans.

As planet earth approaches the next industrial revolution, the conventional supply chains are not the same any longer. All the trends that are widely considered the next economic system shapers are creating numerous opportunities for semiconductor companies. These looming changes are already making themselves felt. For one thing, the combined economic profit of the semiconductor industry worldwide surpassed USD 100 billion in 2017, hitting a new all-time high.

Despite a positive outlook overall, the new era also brings some tough challenges. The consumer electronics market – the main driver of the sector – has been showing clear signs of oversaturation; global smartphone shipments dropped by over 4% in 2018. Besides, virtually all the leading tech corporations, which are the biggest buyers of Integrated Circuits (IC), have launched multiple projects with the aim of building chips in-house. There is an even bigger threat coming from outside of the box: quantum computing and other technologies that may flip the entire microelectronic game are perils for the almost half-a-trillion-dollars-large semiconductor market.

Though the IC business, which, due to its high entry barriers, has never been a good fit for bootstrapped entrepreneurs, the recent tectonic shifts provide the sector's startups with a decent chance to creep onto the international high-tech scene. Today, the fate of a wide gamut of industries hinges on micro-innovation even more than before, and growth-stage companies are becoming more likely to play the role of *deus ex machina* in the inevitable social and economic crises of tomorrow.

In this report, we scrutinize the global semiconductor market, zooming in on the most promising growth-stage companies across a handful of subsectors and tech concepts such as Artificial Intelligence (AI), data centers, the Internet of Things (IoT) and automotive. Through an in-depth analysis of industry trends, we found that the current Private Equity (PE) and Venture Capital (VC) investment landscape not only mirrors existing sketches of the fourth industrial revolution but also leaves hefty dents in the world of innovation.

Ivan Platonov
Author of the report, industry analyst
ivan@equalocean.com

Zhang Fan
Co-founder of EqualOcean
zhangfan@equalocean.com

Huang Yuanpu
Founder of EqualOcean
yuanpu@equalocean.com

Highlights

USD 475 billion
Worldwide semiconductor revenue in 2018
Nearly 10% of the USD 5 trillion global Information and Communications Technology (ICT) market

USD 41 billion
Projected AI chips market size in 2023
USD 7.45 billion in 2018

175 Zettabytes
Projected amount of digital data generated globally by 2025
33 Zettabytes in 2018

USD 10.2 trillion
Expected value contribution of IoT over the next five years
With Industrial Internet of Things (IIoT) contributing USD 3.7 trillion

72 rounds
Number of venture financing events of over USD 10 million carried out by semiconductor startups globally in 2018-19
Nine of them were of over USD 100 million

47.9%
Combined market share of the five largest automotive chip producers globally
The market hit USD 37.7 billion in 2018

After the projected fall in 2019, the global semiconductor market is expected to rebound, reaching a new record in 2023

Global semiconductor market size as the combined volume of the major chipmakers' sales revenues

Note: see page 8 of this report for the sources and other information

- In the next few years, Moore's law is likely to steam up, with transistor allocation taking a three-dimensional shape;
- The Central Processing Unit (CPU) – the 'one-man army' of the semiconductor world – will inevitably lose much of its clout in the industry to Application-Specific Integrated Circuits (ASIC);
- The use of new materials, complex System-on-a-Chip (SoC) integration and other symptoms of 'more-than-Moore' will spur progress across a handful of areas both at different stages of a certain value chain and between verticals that previously weren't linked.

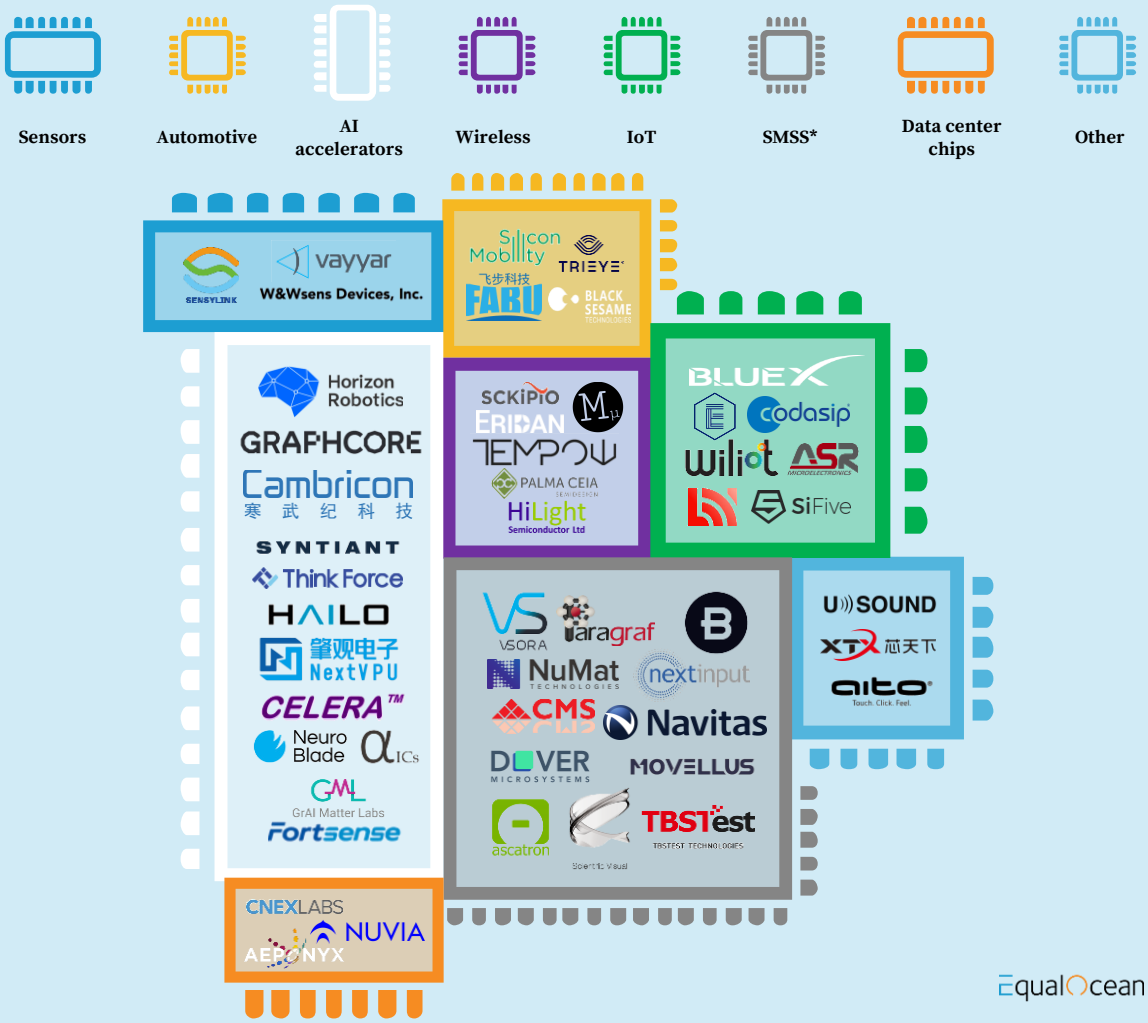
Next global tech 50: microelectronic blacksmiths of tomorrow

Unlike the budding global software startup scene, the semiconductor industry can't boast of a large number of private companies that disrupt the *status quo*. As most of the market segments are dominated by elephantine international corporations, young firms are often not able to keep up with the ever-changing business environment. However, there are a number of aggressive upstarts that are highly likely to win within their chosen industry verticals in the near future.

EqualOcean has compiled a global list of young chipmakers that, according to our analysis, have a strong chance of growing into leading global semiconductor enterprises, by leveraging high technology across various submarkets.

Fifty early-stage startups that are likely to conquer the microelectronics world

Top 50 global disruptive semiconductor upstarts – market map, 2019



*Semiconductor Materials, Services and Solutions

Notes:

The categories chosen are neither mutually exclusive nor collectively exhaustive. Hence, both industry verticals and technological concepts could be found on the list. All the companies are classified according to their market positioning and main revenue streams.

To compile this list, EqualOcean used 12 independent selection criteria (including funding information, market valuation as well as several technological and macroeconomic indicators), which are not affected by any commercial links between the firm and its existing or potential clients.

Black Sesame Technologies also appears on the 'Next Global Tech 50: Automotive and Mobility' list compiled by EqualOcean.

See appendix table for the companies' names, PE/VC funding data and other information

Even more than 'more-than-Moore'? The industry overview

Data collection, transmission and processing – or, to be more precise, the design, speed and accuracy of these processes as enabled by frontline chipmakers – are likely to shape the competitive landscape across a handful of industries.

Several hot technologies are widely projected to become game-changing soon. While mutually interconnected, three of them are linked directly to each of the triad of processes mentioned above.

The upcoming fifth generation of **wireless technology**, known as 5G, will facilitate a major upgrade in data transmission.

Artificial Intelligence is based on iterative data processing and (indeed, not by coincidence) is used to make this process quicker, smarter, more accurate and, eventually, automatized and self-sustainable.

Internet of Things, a phenomenon described by another buzzword in the tech and investment circles, being a 'smart' combination of interconnected devices, has all the chances to accelerate the data collection process in sophisticated quasi-physical ecosystems.

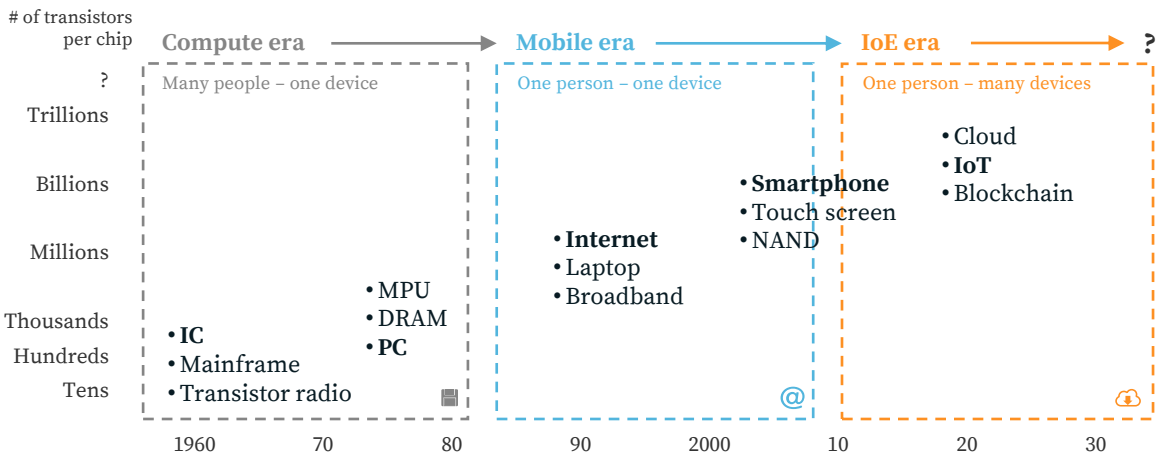
All these miraculous pieces of evidence for human civilization's technological progress have a common point. Though it's been a long way since low-capacity computers occupying several rooms and creaking just to multiply four-digit numbers (till today's super-productive handsets and autonomous robots), the nature of data hasn't changed. People still interpret their lives via zeros and ones, whether they are aware of it or not. And, as is commonly known, there is a tiny on-off switch for every binary signal – a transistor.

Transistors are clustered together, making up a computer chip. Chips, in turn, are parts of ICs, which are 'in charge' of distinct functions in every single electronic device around the world. And, finally, devices generate, interpret, preserve information of all types, which makes them the core element of modern digitalized systems and, at the same time, the main lever to compete on the global technology scene.

A classic example of a value chain, it shows the atomic structure of what is called 'tech' in a broad sense. And this is arguably enough to explain the pivotal role of semiconductor companies in this data-driven world of today –

The digital universe has been evolving rapidly over the last half-century

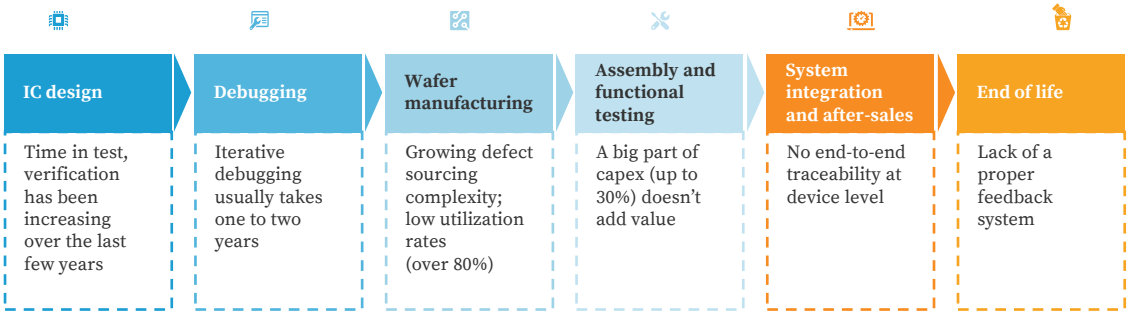
Three waves of the semiconductor industry's evolution and technologies that are shaping global demand for chips



Notes: Emboldened are the pivotal technologies that changed the nature of demand for electronics
Acronyms in this chart include following: IC = Integrated Circuit; MPU = Microprocessing Unit; DRAM = Dynamic Random-Access Memory; PC = Personal Computer; IoT = the Internet of Things; IoE = the Internet of Everything
Source: EqualOcean analysis

Multiple opportunities exist within the semiconductor value chain

Current state of semiconductor value chain



Note: The upper blocks indicate various stages of the supply chain, the lower blocks contain key hurdles at each of them
Source: McKinsey, EqualOcean analysis

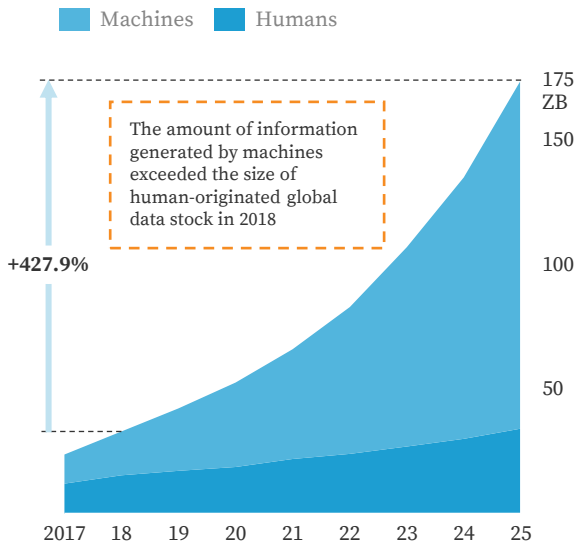
or the even-more-data-driven world of tomorrow, as they are not only the creators of all the 'micro', 'nano', 'pico' and so on but also the guides that walk the 'tech' through the thorny path from transistors to IC.

Together, chipmakers account for nearly 10% of **the USD 5 trillion global Information and Communications Technology (ICT) market**. The semiconductor industry was worth roughly USD 475 billion in 2018 and is expected to hit USD 520 billion in 2023, growing at a 4.9% CAGR.

The main driver of the sector's growth is a huge demand for data that exists within a broad spectrum of industries and applications. These days, precise and solid digital information is the most wanted of assets as it helps to reduce a degree of uncertainty, which is vital to tailoring competitive business strategies. The amount of data generated worldwide is thereby destined to

The global datasphere might peak at 175 ZB by 2025

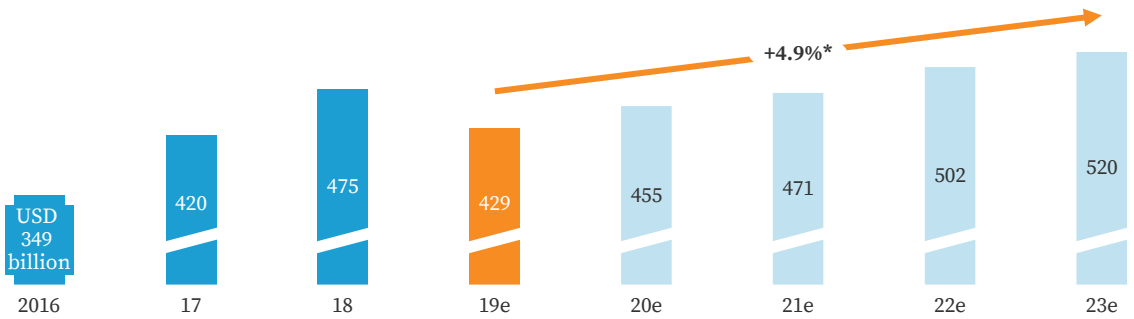
Digital data generated globally by



Note: ZB = Zettabyte
Source: IDC, Semicon Europa, EqualOcean analysis

After the projected fall in 2019, the global semiconductor market is expected to rebound, reaching a new record in 2022

Global semiconductor market size as the combined volume of the major chipmakers' sales revenues



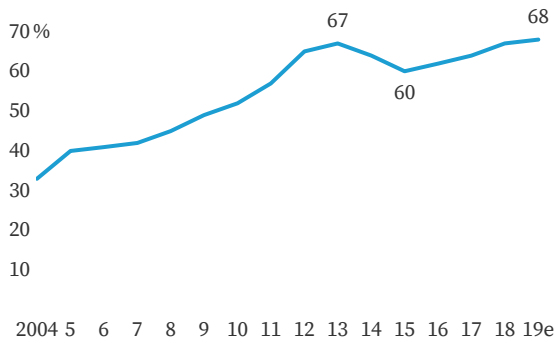
*CAGR (Compound Average Growth Rate) 2019-2023
Source: IHC Markit, SEMI, Gartner, IC Insights, PwC, EqualOcean analysis

experience a boom in the following years.

The upcoming industrial revolution is recognized and well assessed by the largest chipmakers, most of which have been in the game for a long time, accumulating the experience that is necessary to survive imminent technological shifts and thrive in the new paradigm of interplay between technology and economy.

The race for global innovation advantage gets more severe

The share of semiconductor industry capital spending held by the top five companies*



*Samsung, Intel, TSMC, SK Hynix and Micron
Source: IC Insights, EqualOcean analysis

Vast heaps of money have been recently thrown at research and development by industry leaders. Meanwhile, we see an influx of startups seizing the fresh opportunities that are now emerging thanks to the rapid spread of state-of-the-art technology and the ever-expanding ICT industry.

These new 'tech facilitators' are, of course, invested in, albeit not as lavishly as most of rockstar software and Internet companies that often go public with sky-high P/Es. One reason is that **chipmakers' projected return numbers are, in most cases, quite far from private investment firms' hurdle rates for early-stage startups**.

This, obviously, has something to do with relatively high capex and R&D costs. Even some big players in the sector struggle to turn toward sustained profitability. Foundries, which depend on the interplay of several external issues, including macroeconomic shifts and business cycles, are the extreme case.

Despite capital pressure, private businesses in the sector have more room to create, invent and develop, as never before.

In the following chapters of this report, we make an attempt to depict current trends in the semiconductor industry and our understanding of the market landscape. We pay special attention to three subsectors:

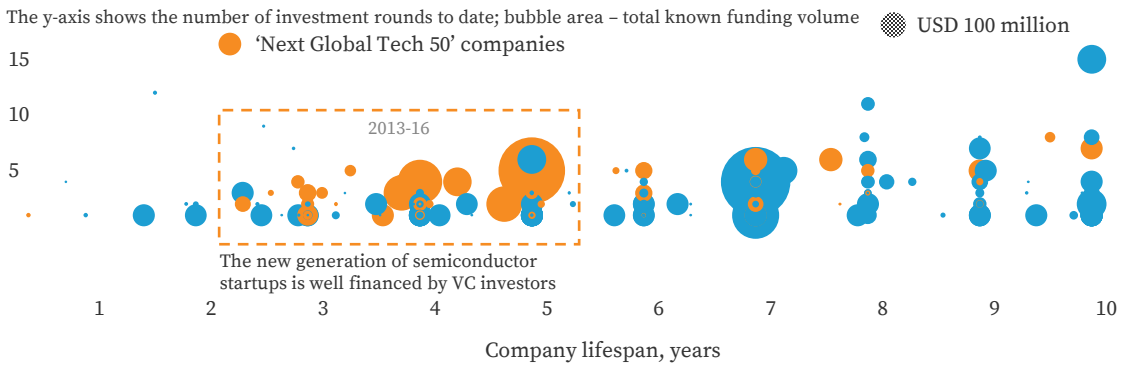
AI accelerators – highly specified hardware for 'pure digital' fields like machine learning;

IoT chips – sensors and other ICs that are designed to connect physical and digital worlds;

Automotive chips – cutting-edge hardware applied to a variety of transportation tools.

Founded between 2013-2016, the new gen of chipmakers is likely to shake the startup scene

Private chipmaking companies founded in the past ten years: lifespan and investment activity



Note: Data on 375 startups founded after 1/1/2009 were used
Source: EqualOcean analysis of Crunchbase database

Depth and precision: accelerating Artificial Intelligence

AI has been in the spotlight for a while. The original quest to develop programs and machines that can obtain, process and create information intelligently has produced both powerful applications and a flurry of hype. The 'AI' buzzword is now extensively used by startups to attract early-stage investment, regardless of the nature of the business model and whether Deep Learning (DL) algorithms – the essence of AI – are actually part of their core product. In short, there is plenty of excitement around the concept, with no lull likely to happen soon.

Obviously, a brand-new generation of hardware is needed to move back and forth the ever-expanding troves of data and run sophisticated iterative learning algorithms. The microelectronics sector is the key source of innovation in this field.

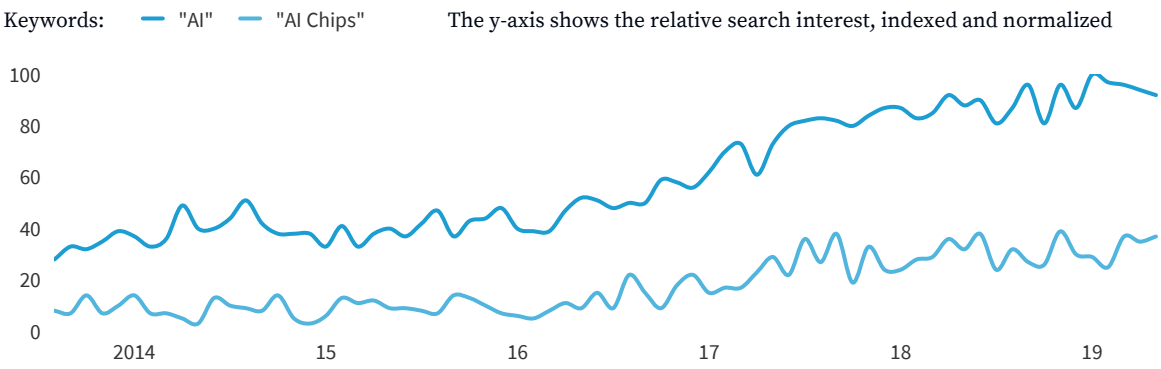
AI accelerators – specialized chips meant to hasten the process of managing information – are destined to become the main differentiating tool in intertwined ecosystems of the upcoming omnipresent 'Industry 4.0.' Memory, storage, logic and networking are the main directions where semiconductor companies are fine-tuning their devices to enable carefully constructed AI code to run faster, deeper and more precise analyses.

There are two major shifts expected to occur in this realm. First, **leading global corporations intend to create their own, completely independent AI-based products**, which will lead to in-house chip development projects and trigger the tech giants to employ more aggressive market strategies. We expect the number of acquisitions of small, narrowly specialized upstarts by leading Internet companies to grow sharply in the following five years. This trend poses grim challenges for semiconductor conglomerates – entities from which an overwhelming majority of micro-components had been outsourced before the recent oversaturation in the global consumer electronics market.

The second projected change is structural – and it is, in many respects, the factor that may force the abovementioned behemoths to diversify. As specific tasks in AI benefit from hardware designed to handle their needs as narrowly as possible, the role of the **Central Processing Unit** (CPU) – the 'one-man army' of the semiconductor world – **will inevitably lose much of its clout in the industry**. In terms of getting up steam, Application-Specific Integrated Circuits (ASIC) have already begun a quest to conquer both edge architecture and data centers, pushing CPUs out of the scene.

AI has constantly been in the limelight over the past five years

Google Trends: global news coverage keyword popularity index, January 2014 – October 2019



Source: Google, EqualOcean analysis

ASIC-makers' ambitions are also destructive for another two kinds of component: Graphics-Processing Units (GPU) and field-programmable gate arrays (FPGA). While the former will almost certainly lose their ground in AI training in data centers, the latter might have some room in the edge due to their ability to be easily reprogrammed and flexible in terms of possible applications.

The market

There have already been several milestones in the sector that can help us to assess the magnitude of the nascent market. Intel, the undisputed champion in the CPU domain, reportedly sold USD 1 billion of AI chips in 2017. However, its nemesis, GPU segment veteran Nvidia, palms off a comparable amount of ICs, virtually dominating in the image recognition supporting hardware field and some other areas. Their products power Facebook, Google and a bunch of other digital pioneers. Taiwan-based TSMC, currently the world's biggest contract chipmaker with a market cap of over USD 250 billion, has also launched a number of projects aimed at building world-class accelerators. Together with Los Altos, California-based startup Cerebras, it has developed the largest processor ever built – the "supercomputer-on-a-chip," Wafer Scale Engine, with a record-breaking 1.2 trillion transistors.

These and other huge industry players, such as Korean megacorporation Samsung, AMD (another GPU leviathan), Xilinx and Altera (both are well known for their FPGAs) formed a seven-billion-dollar artificial intelligence chip market in 2018.

Growing at a 59.5% CAGR over the past three years, the AI sector saw increasing (from 8.2% in 2016 to 10% in 2018) value contribution from semiconductor providers. Spurred by the capital being pumped into hardware projects around the globe, this proportion is expected to balloon in the next few years, exceeding 18% by 2023.

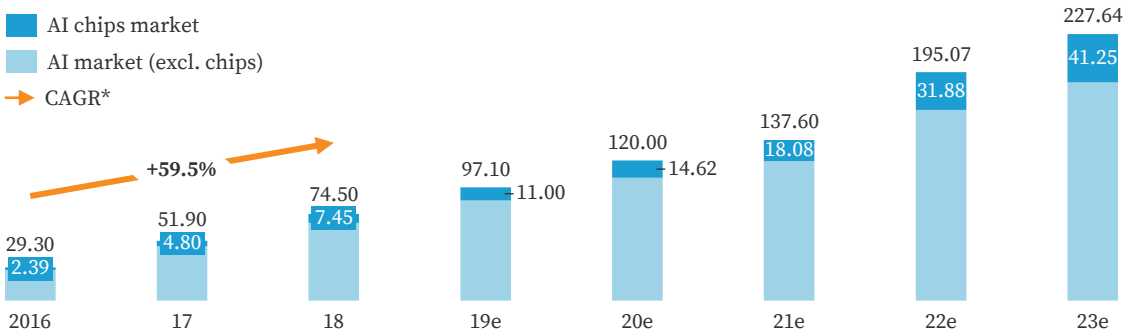
In the ultra-short run, however, the growth won't be that impressive, as the market is likely to face an overcapacity crisis caused by the extremely high costs reported in 2018 by the leading powerhouses: **Samsung, Intel, SK Hynix, TSMC and Micron spent over USD 71 billion in semiconductor capex** that year, up 16% from 2016's USD 61.4 billion.

Startups?

While the deep-pocketed international companies can easily hop into this emerging field, lashing out heaps of capital on various research and development projects, young

Semiconductor companies are expected to produce over USD 100 billion in AI chips by 2023

AI technology and AI semiconductor global market size, USD billion



*Compound Average Growth Rate
Source: Deloitte, Gartner, IHS Markit, SEMI, EqualOcean analysis

private companies have a hard time competing against the leading clique.

Financial stringency – one of the key distinguishing features of 'from-zero-to-one' entrepreneurship – seems to be an insurmountable barrier for those who try to make a difference by designing and manufacturing microelectronic hardware for AI outside of ecosystems that are constructed and maintained by the big industry names.

This, nevertheless, doesn't imply complete independence. Even the high and the mighty create strategic alliances. Not to mention growth-stage rookies that always need extensive coaching and backing or, at least, bean-counting creditors to get their businesses off the ground.

In other sectors, a burgeoning global startup scene has proven itself a cradle for industrial innovation multiple times. Retail, education, entertainment and other consumer-oriented domains, in which business models and market positioning matter way more than the core technology, have each seen herds of unicorns – startups valued at over USD 1 billion – coming from both advanced and emerging worlds.

Offspring of the semiconductor industry, where technology is the heart, not a limb, need tremendous piles of investment to keep pace with an ever-changing international environment. Moreover, unlike the zephyrian software business, where money can follow a sufficiently beguiling pitch before a product takes shape, bright ideas are far from enough to raise cash for making chips.

What potential backers need here is confidence in product quality. From humble beginnings, such as angel, seed and early-stage investment rounds, to the phases closest to the IPO, the 'show me what you are capable of' principle is the first and the most popular for PE/VC money managers.

The traditional 'we first look at the team and market orientation' concept is put on the back burner. In other words, investors in hardware are frugal by nature.

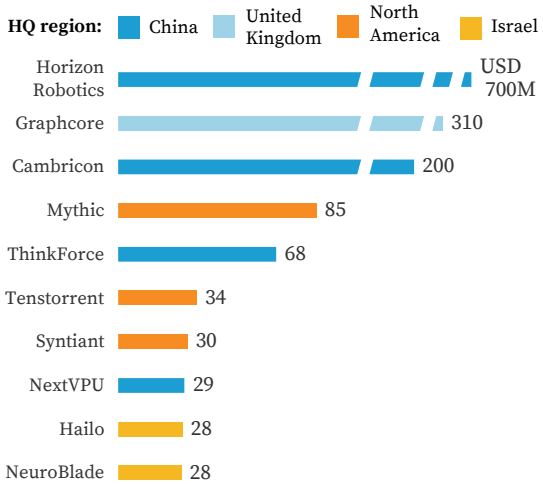
"Real men have fabs"– the oft-cited quote by AMD founder Jerry Sanders is now, apparently, more than just a motto for those acting at the intersection of AI and microelectronics. This, indeed, doesn't mean that all the startups devoted to producing accelerators are leaning towards one-stop instant mass production. On the contrary, only some of them provide complete end-to-end hardware solutions carried out without outsourcing mask services, assembly, functional testing, packaging or other capital-intensive phases of the semiconductor value chain.

Money in

In the previous three years, AI semiconductor startups have obtained nearly USD 1.7 billion in 20 of the largest financing deals (Series A-D). It is important to note that USD 1.1 billion, or almost 65% of this amount, has been secured by three companies: Beijing-based 'AI supermarket'

Ten AI chip startups have bagged USD 1.51 billion in total

Top 10 money-raising early-stage AI chip startups



Source: Crunchbase, CB Insights, EqualOcean analysis

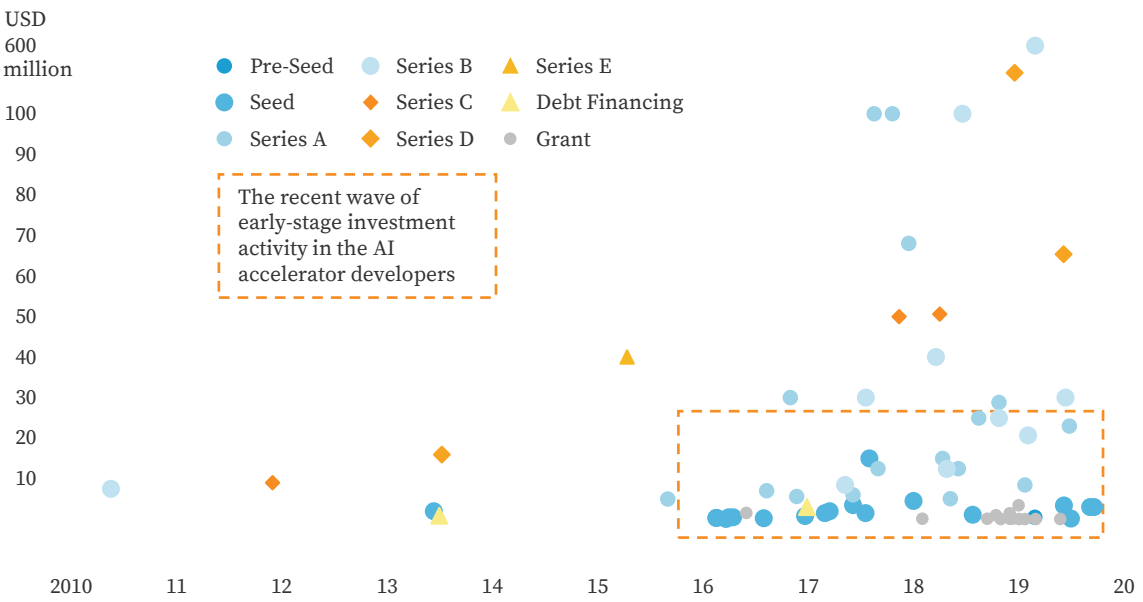
Horizon Robotics, DL processor developer Cambricon and the Intelligence Processing Unit (IPU) pioneer, Bristol-headquartered company Graphcore. The three are currently valued at USD 3 billion, USD 2 billion and USD 1.7 billion respectively. Though these numbers are miniscule compared to multibillion market caps of the industry big names, they are quite weighty in AI segment.

China-based upstarts are apparently seizing fresh opportunities that are coming from the country's state-level strategies designed to facilitate the next 'great leap forward.' Meanwhile, the United States is clearly lacking big-scale microelectronics innovators other than Intel, Qualcomm and the rest of internationally acclaimed kingpins. However, 'does this fact make any difference?' is a tricky question to answer.

The AI semiconductor segment is not only harsh for penniless newcomers but also highly polarized and, following the never-fading Moore's law, we see market entry barriers lift up over time. Nonetheless, microfabrication is part of the value chain where real innovation happens. As Sir Francis Drake would say, *sic parvis magna* – "From small things comes greatness." It seems like more and more of the technologically and financially ambitious are taking this to heart nowadays.

The hype around Artificial Intelligence is mirrored in the global venture capital structure: more AI chip startups obtain investment these days

Recent rounds of financing carried out by growth-stage AI accelerators manufacturers globally



Note: investment data on 89 events were used
Source: EqualOcean analysis of Crunchbase database

‘Connected everything’: building the Internet of Things

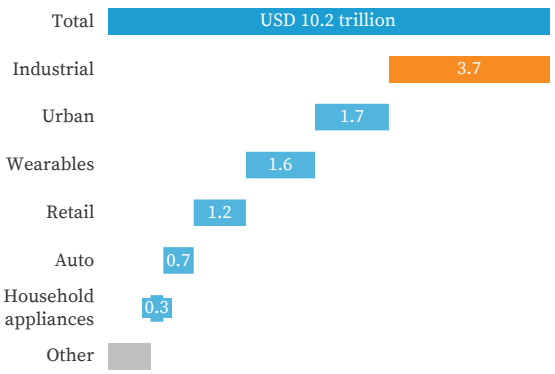
Probably the greatest concern of semiconductor companies these days, the Internet of Things, is a concept that is widely considered the *novus ordo seclorum* of almost every industry. On the surface, by bringing technology closer to the final user, it enriches consumer experience and is making people more connected than ever (this is demonstrated by the recently booming smart home and wearables markets). More important may be the main value-added feature of IoT in its effect on a large number of traditional supply chains.

Virtually all the processes within the modern economic system, from old-but-not-obsolete sectors like mining and ranching to intangible activities such as B2B professional services, are now exposed to IoT-based disruption. For industrials, this means that the new phase of connectivity is able to take the brilliant Japanese Supply-Chain Management (SCM) invention – the Just-in-Time (JiT) manufacturing system – to the next level.

Another neologism, the Internet of Everything (IoE) – which is, simply put, an upgraded version of IoT – is based on ubiquitous, wireless connectivity. Not only physical devices but literally *everything* can become a part of interconnected networks. Integrated data centers, cloud and edge computing come together to shape the global information landscape. The new web resembles a digital organism that not only records and imitates real things – it goes further by constructing a completely new, virtual universe.

IoT might add over USD 10 trillion to the global GDP by 2025

Projected economic impact of various IoT segments

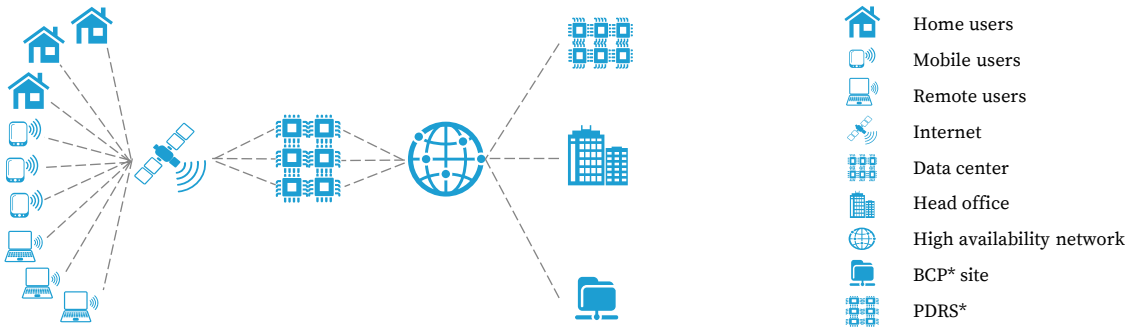


Source: McKinsey Global Institute, EqualOcean analysis

At the moment, the business world is, obviously, being shaken by the abundance of ways to deal with data of any kind. Omnipresent sensors, vast memory storage capacities and smart optimization algorithms, designed to keep managers informed over time, provides details about the tiniest changes within their production ecosystems. The spreading organization models have already become

Leveraging connectivity, the Internet of Everything comprises a plethora of data centers that span all across the globe

Basic data center framework: core elements, links and users



*Business Continuity Planning; **Provisioned Disaster Recovery Servers
Source: EqualOcean analysis

a matter for fierce international competition.

According to McKinsey Global Institute, potential economic impact of various **IoT applications worldwide will reach at least USD 3.9 trillion in the following five years**. In the global consultancy's most optimistic scenario, this number will hit USD 11.1 trillion. Sectors like manufacturing are prone to be affected by the technology the most, with the Industrial Internet of Things (IIoT) adding up to 40% of this amount.

'Connectivity' needs 'connectors'

The three key pillars of the digital era – data collection, transmission and processing – require proper hardware to run on. Key to this is a long list of sensors of different kinds, processing units, which have been an object of stiff market rivalry between the world's biggest corporations for several decades, a plethora of memory chips and other micro solutions. It gets even more complex at the IC level: ASICs are not only expected to dominate AI training, but they also have something to say in the area of interconnected devices systems.

Another Pandora's box?

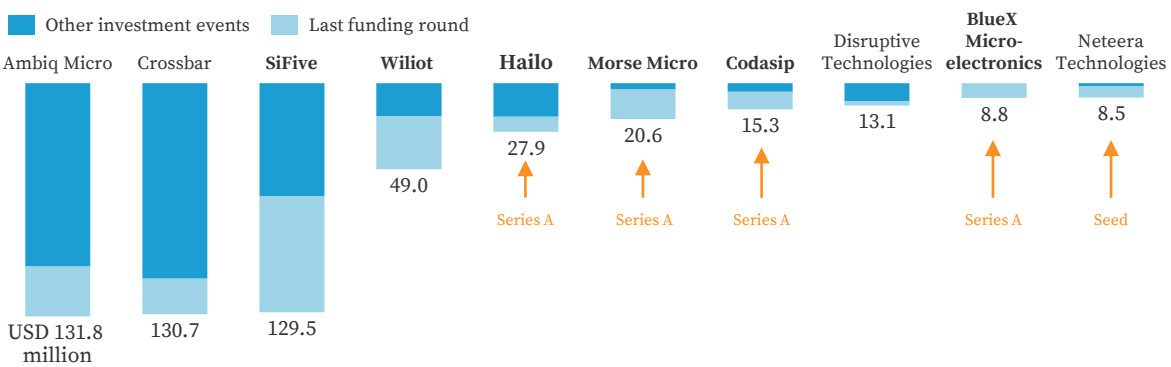
As the devil is in the details, every new solution is tightly related to infinite security concerns. At the confluence of firmware and hardware in IoT, there are multiple pain points that need to be alleviated in order to prevent data theft and other illegal activities harmful for businesses.

Hence, as the market balloons on the backs of adjacent subfields, it makes obvious the fact that this 'new world order' is creating a spacious room for semiconductor industry players. And this is seemingly well understood by the majority of the flagship chipmakers. From pure cloud computing to open hardware-as-a-service-like IoT platforms – a bunch of new business models have been developed by the likes of Intel and ARM.

Remarkably, **IoT enables startups to have more space for making innovative ideas come into fruition**. One reason is that the scope here is larger than, for instance, that of AI technology. As a result, a huge number of companies have emerged over the recent years. Investment data accelerator Crunchbase has reported on 6,201 private firms founded within the past ten years that strive to make money by leveraging IoT. However, there are only 33 chipmakers among them, which indicates the relative ease of 'outsourcing everything physical' – i.e., purchasing independent pieces of hardware to combine them into smart ecosystems, creating enormous networks of integrated solutions.

Though the Internet of Things field is yet to have a semiconductor unicorn*, several upstarts have entered the late-stage phase in just a few years

Selected global private companies-IoT chip producers, total amount of known funding



*A unicorn is a privately held startup company valued at USD 1 billion or more
Note: Emboldened are the 'Next Global 50' companies
Source: Crunchbase, CB Insights, EqualOcean analysis

Comfort and safety: implanting automotive electronics

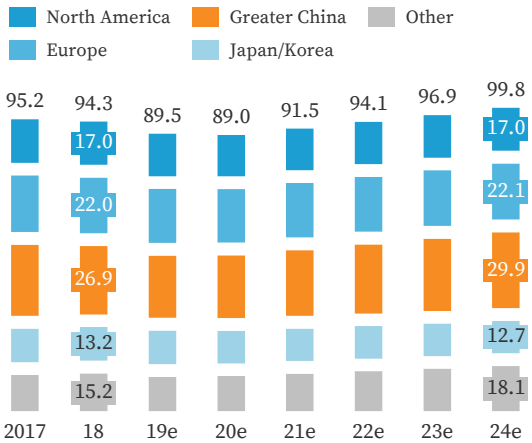
As technology advances over time, the nature of mobility undergoes considerable changes. While innovative ideas like the Internet of Things – and, consequently, business models that are based on them – naturally disrupt the core methods of 'data transportation,' the physical ways to move things (and people) from one place to another are gradually improved.

Major transportation tools have been evolving for a long time, mostly because of technological progress in the fields of mechanics, chemistry and other areas that were developed and theorized long ago and now are improving gradually. Nevertheless, the industry can no longer rely solely on the classical drivers of advancement. Stirred by international rivalry, car makers around the globe have no choice but to adopt the best technologies across the value chain in order to differentiate their final products.

At the moment, safety and comfort are the major directions of product differentiation in automotive. To increase these two, the world's leading corporations spend a lot of money on micro-innovation in four realms: electrification (as a result of the recent energy revolution), absolute automation (a long-term process that is widely considered the final step in the sector's development), connectivity (a ubiquitous force that is enabled by the combination of physical and digital worlds, which continue to enmesh, making digitalization more pervasive on a large scale) and security (including both digital and physical aspects).

Global auto market is expected to expand slightly by 2024

Light vehicle production worldwide, million units

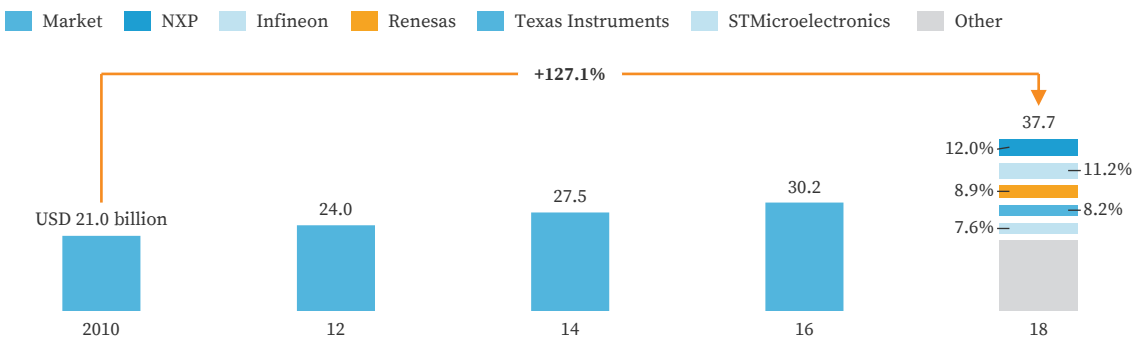


Source: IHS Markit, Infineon, EqualOcean analysis

As the market steps into the phase of oversaturation, the number of cars sold planetwide isn't growing rapidly. Moreover, the industry is projected to dwindle in the next two years, indicating deteriorating economic conditions across several key areas. Still, the struggle for innovation is commonplace among

Five biggest chipmakers hold almost half of the global automotive semiconductor market, which has been steadily growing since 2010

Global automotive semiconductor market size and the largest players



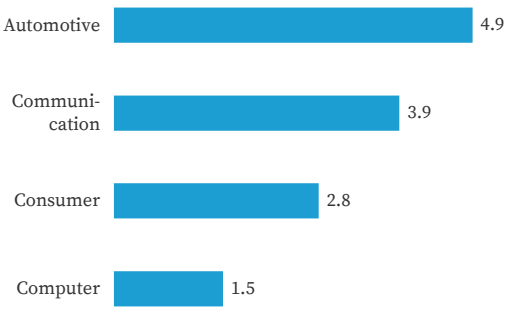
Source: IC Insights, Strategy Analytics, IHS Markit, Infineon, EqualOcean analysis

the biggest car manufacturers. All the four abovementioned emerging zones palpably rely on micro-components such as memory chips, sensors and processors.

For semiconductor companies, Advanced Driver-Assistance Systems (ADAS) is the most attractive domain in the automotive industry. However, opportunities exist in many other vehicle subsystems. According to Deloitte, semiconductor content per car is projected to hit USD 600 as soon as 2022. One of the auto chip market leaders, German company Infineon, predicts that driving automation Level 4-5 models will, on average, contain up to USD 970 of semiconductor content per car by 2030.

Automotive electronics is among the most fast-growing sectors

Compound annual growth rate for electronics systems, 2015-2020



Source: IC Insights

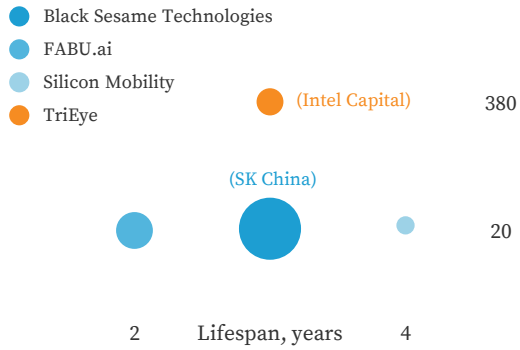
Another behemoth, Dutch multinational NXP Semiconductors, projects that electronics of all kinds will account for over 50% of total car cost by 2030. Safety, fuel efficiency, comfort and infotainment are frequently considered the key drivers that enable this shift.

As things stand, electronic systems are becoming the most important battlefield in the global market. Meanwhile, there is a fine line between 'innovative solutions' and 'solutions that can be easily applied to the mass production.' The strict economics of car making, gingered up by the powerful market demand, place limitations on the research and development, generating limitless hurdles for private companies. It is obvious that the automotive industry is far from being a honey pot for startups, especially in advanced economies with well-established firms that have an expanded access to state-of-the-art technology and even run in-house projects, pursuing self-sufficiency.

However, there are some young players that are striving to make a difference within narrow segments of their respective supply chains.

Auto chip startups are seemingly on the track to be acquired soon

Four 'Next Global 50' automobile chip startups: funding, lifespan, backers' power



Note: y-axis shows the maximum number of exits made by one of the firm's backers
Source: Crunchbase, ITjuzi, EqualOcean analysis

Intel-backed TriEye develops image solutions for ADAS and autonomous driving systems. Its core product, the Raven SWIR Camera, is used to combat low visibility. Besides applications in automotive, the firm claims that the optical instrument can be employed in smart cities, industrial settings and agriculture.

Black Sesame Technologies, which is, like many other lately emerged autonomous driving startups, based in Silicon Valley and China's Mainland (Shanghai, to be exact) plays on the adjacent field. Besides image processing and light control, it also markets perception systems and facial recognition tools. SK Hynix's Chinese branch has pumped venture capital into the firm in April 2019, joining NIO's investment arm and some other locally known names.

Great Expectations? The near future of chips

Following the course of the gigantic global ICT industry, the semiconductor market will continue its rollercoaster ride, guided by the titans' financial statements and, to be more precise, their projected costs for each forthcoming quarter. While there are several concerns about the shrinking global consumer electronics market, as well as whether this downturn will continue to plunder the world's leading companies' capital, technological aspects of the semiconductor industry's tomorrow are, surprisingly, more certain.

- The basis and the root cause of the extensive growth of the sector – Moore's Law – is more than 'alive;' with the likes of 3D NAND getting momentum, it is about to take a new shape in the short run, accelerating the more-transistors-in-less-space story to 'beyond Moore' levels.
- Multiple burgeoning business models are likely to catalyze a new type of interplay between technology and application. Looking back, it seems clear how the first half of the 20th century laid the groundwork for the era of connectivity by coalescing the complex supply-side tech we rely upon so deeply. Now, the table is going to tilt over as demand-side players start calling the shots.
- The use of new materials, complex SoC integration and other symptoms of 'more-than-Moore' will spur progress across a handful of areas both at different stages of a certain value chain and between verticals that previously weren't linked. Enabled by advanced chemistry, micro-engineering and data science, the slightest change in the chips' structure might significantly shake global markets.

These trends are generating both risks and opportunities for private semiconductor businesses around the world. Removed from the cutthroat competition represented by industry goliaths, they will have more room to achieve commercial success by driving innovation within the tiniest segments of the digital economic system.

Appendix

Resulting from continuous industry analysis, EqualOcean has compiled the '**Next global 50: microelectronics blacksmiths of tomorrow**' list, which contains selected semiconductor startups that are likely to shake the industry landscape in the near future.

Company name	Category	Country	Founded year	Last funding type	Last funding amount, million USD
AEPONYX	Data center chips	Canada	2011	Series A	5.93
Aito	Other	The Netherlands	2012	Series C	8.3
AlphaICs	AI chips	India	2016	Series unknown	Undisclosed
Ascatron	SMSS*	Sweden	2011	Series B	3.95
ASR Microelectronics	IoT chips	China	2015	Series B	100.00
Baum	SMSS	South Korea	2016	Series A	1.00
[1]Black Sesame Technologies	Automotive chips	United States/China	2016	Series B	100.00
BlueX Microelectronics	IoT chips	China	2015	Series A	8.76
Cambricon	AI chips	China	2016	Series B	100.00
Celera	AI chips	United States	2018	Seed	3.00
CNEX Labs	Data center chips	United States	2013	Series D	23.00
Codasip	IoT chips	Germany	2014	Series A	10.00
Crystalline Mirror Solutions	SMSS	Austria	2012	Series A	0.75
Dover Microsystems	SMSS	United States	2017	Seed	6.00
Edgecortix	IoT chips	Japan	2019	Seed	3.00
Eridan Communications	Wireless	United States	2013	Series A	Undisclosed
FABU Technology	Automotive chips	China	2017	Series A	25.00
Fortsense	AI chips	China	2017	Series B	13.99
GrAI Matter Labs	AI chips	France	2016	Series A	15.00
Graphcore	AI chips	United Kingdom	2016	Series D	200.00
Hailo	AI chips	Israel	2017	Series A	8.50
HiLight Semiconductor	Wireless	United Kingdom	2012	Series C	20.00
Horizon Robotics	AI chips	China	2015	Series B	600.00
Lightning Semiconductor	IoT chips	China	2016	Series A	Undisclosed
Morse Micro	Wireless	Australia	2016	Series A	16.48
Movellus	SMSS	United States	2014	Series A	6.00
Navitas	SMSS	United States	2013	Series B	25.00
NeuroBlade	AI chips	Israel	2017	Series A	23.00
NextInput	SMSS	United States	2012	Series B	13.00
NextVPU	AI chips	China	2016	Series A	28.80
NuMat Technologies	SMSS	United States	2013	Series B	12.40
Nuvia	Data center chips	United States	2019	Series A	53.00
Palma Ceia SemiDesign	Wireless	United States	2012	Series B	1.52
Paragraf	SMSS	United Kingdom	2015	Series A	16.02
Scientific Visual	SMSS	Switzerland	2010	Series B	Undisclosed
Sckipio Technologies	Wireless	Israel	2012	Series D	10.00
Sensylink	Sensors	China	2015	Series B	Undisclosed
SiFive	IoT chips	United States	2015	Series D	65.40
Silicon Mobility	Automotive chips	France	2015	Series B	10.00
Syntiant	AI chips	United States	2017	Series B	25.00
TBSTest Technology	SMSS	China	2017	Series A	10.00
Tempow	Wireless	France	2016	Series A	4.00
ThinkForce	AI chips	China	2017	Series A	64.13
TriEye	Automotive chips	Israel	2016	Series A	2.00
Usound	Audio	Austria	2014	Series C	9.96
Vayyar	Sensors	Israel	2011	Series C	45.00
VSORA	SMSS	France	2015	Series A	1.70
W&W Sens	Sensors	United States	2014	Series C	3.00
Wiliot	IoT chips	Israel	2017	Series B	30.00
XTX Technology	Other	China	2014	Series B	38.00

*Semiconductor Materials, Services and Solutions

[1] Black Sesame Technologies also appears on the 'Next Global Tech 50: Automotive and Mobility' list compiled by EqualOcean.

Notes:

The categories chosen are neither mutually exclusive nor collectively exhaustive. Hence, both industry verticals and technological concepts could be found on the list. All the companies are classified according to their market positioning and main revenue streams.

To compile this list, EqualOcean has used independent selection criteria, which are not affected by any commercial links between the firm and its existing and potential clients.

For more information, visit www.equalocean.com or contact us at contact@equalocean.com.