Industry Focus: Semiconductors

Innovation & Intellectual Property Rights

White Paper

Aalbun

The world's first IP PaaS provider

Contents

Executive Summary

The semiconductor market is performing a balancing act.

On one hand, its importance is unquestionable. It contributes the chips that are the fundamental building blocks of our modern digital world, providing the platform for mass global communication and advanced computing.

But on the other, it is an industry plagued by shortages, at the mercy of historical geo-political tensions, vulnerable to supply chain bottlenecks and riddled with issues of intellectual property theft.

How have we arrived in a situation where an industry that is so vital to our way of lives is so vulnerable and facing an uncertain future?

As with every industry, the semiconductor market has had to deal with the challenges of Covid-19, but with the extra headache that the pandemic has exacerbated what were already existing problems: tensions between China and the U.S., the ensuing trade war between the two, supply chain bottlenecks, global shortages of chips, etc.

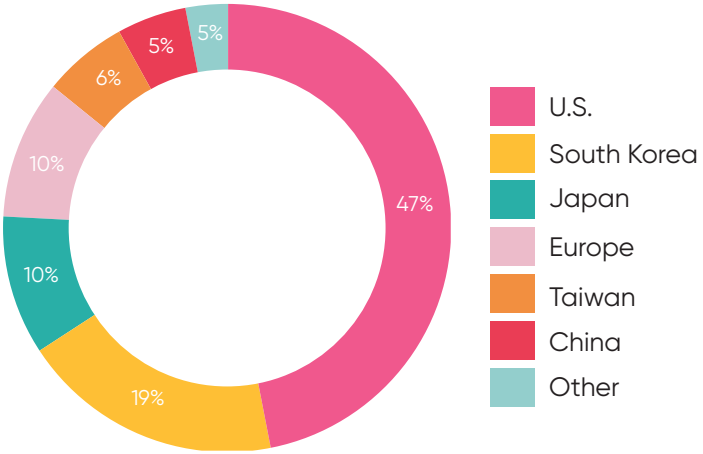
Consider also the unintended consequences that the pandemic has thrown up. With the push to work remotely a global phenomenon, cybersecurity for remote work has become an even more pressing issue for semiconductor companies who know their intellectual property and technological know-how is the most important asset they own.

Or consider the ballooning costs of R&D that goes into keeping the semiconductor industry at the sharp-edge of technological innovation. Falling revenues from chip shortages and an increase in consumer demand means tough budgeting decisions must be made sooner rather than later.

The following is our attempt to highlight the big themes and issues dominating the semiconductor industry and how they and the events of the pandemic will impact on innovation and intellectual property rights in the sector going forward.

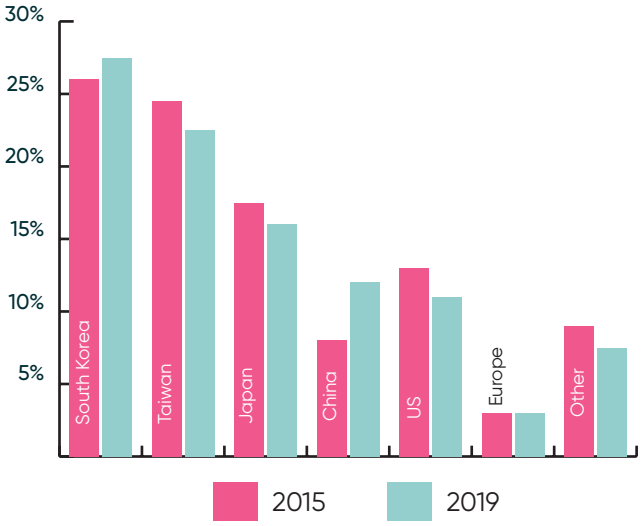
The Semiconductor Industry At a glance

Global semiconductor industry sales market share by nationally HQ company, 2019



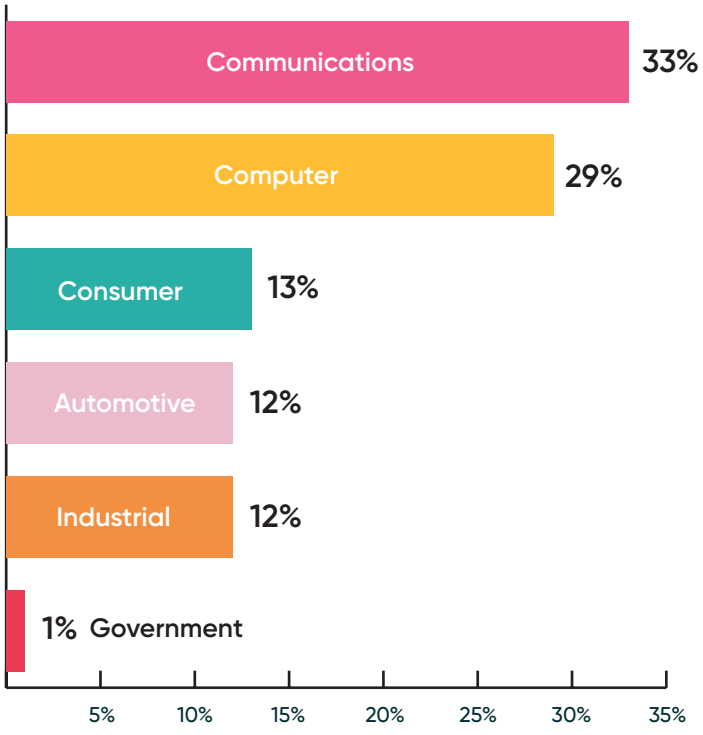
Source: SIA: 2020 State of the U.S. semiconductor industry

Global semiconductor fabrication capacity by country, 2019



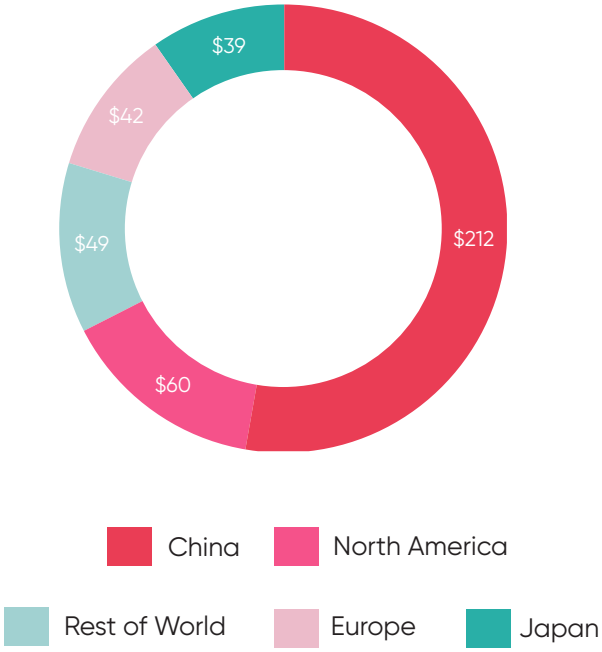
Source: IFIT: Moore's Law Under Attack: The Impact of China's Policies on Global Semiconductor Innovation

Total Global semiconductor demand share by end use, 2019



Source: SIA: 2020 State of the U.S. semiconductor industry

Global semiconductor consumption by region (billions), 2019



Source: IFIT: Moore's Law Under Attack: The Impact of China's Policies on Global Semiconductor Innovation

The Challenges Facing the Semiconductor Industry in 2021 and Beyond

During the past year, the world's focus has been trained on the Covid-19 pandemic. Governments, businesses and entire industries have naturally been attempting to navigate obstacles and challenges that the Covid-19 virus has brought.

All the while, in the background there has been another threat to global stability that has been quietly growing for the past few years and is coming to a head in 2021.

The importance of semiconductors in our daily lives should be well known by now. They represent the heartbeat of the essential components of the electrical devices that power and enrich our digital lives. Smartphones, computers, pacemakers, household appliances, life-saving equipment, military equipment, transport, clean energy are all examples of such electrical devices. The list of modern industries and technologies that harness semiconductors is truly all-encompassing.

Crucially, semiconductors and the chips they enable are perceived as being key to the next step of this fourth industrial revolution that we are currently witnessing. Artificial intelligence (AI), the Internet of Things (IoT), quantum computing, machine learning are such next step and semiconductors will be the brain of the next phase of the digitalisation of our world. Their importance cannot be overstated.

Naturally, the ubiquity and usefulness of semiconductors have translated into mind-boggling numbers in terms of trade, revenues and budgets. The semiconductor market itself was valued at $488 billion (USD) in 2021 and this figure is forecasted to reach $803 billion (USD) by 2028 – a CAGR of 9%[1].

To put that $803 billion figure into perspective, it is greater than the GDP of every country outside the top 20 leading countries involved in such technology[2]. The companies at the top end of the market are some of the most innovative in the world and they have corresponding R&D budgets to match. All things told, the semiconductor industry is an engine of contemporary global economic growth.

But if this is to be the golden age of semiconductors, all players involved in the industry – from government bodies to R&D teams – must find solutions to pressing security and intellectual property theft issues that are clouding current and future markets.

In the short term, supply chain issues that are plaguing the industry are arguably the most pressing. Demand has reached unprecedented levels and the concentration of semiconductor knowledge and manufacturing capability in a few hands, coupled with uneasy trading relationships, has meant that the industry is riddled with potential bottlenecks that need resolving.

Longer-term, there is a rising tension and concern around the relationship between two of the global semiconductor powers, China and the USA, as well as associated concerns about Taiwan and its crucial role in the balance of the semiconductor global supply chain. Ongoing disputes that go beyond just the semiconductor industry show no sign of abating between these two major nations, and a significant thawing in tensions needs to occur before issues associated with the disputes can even begin to be resolved.

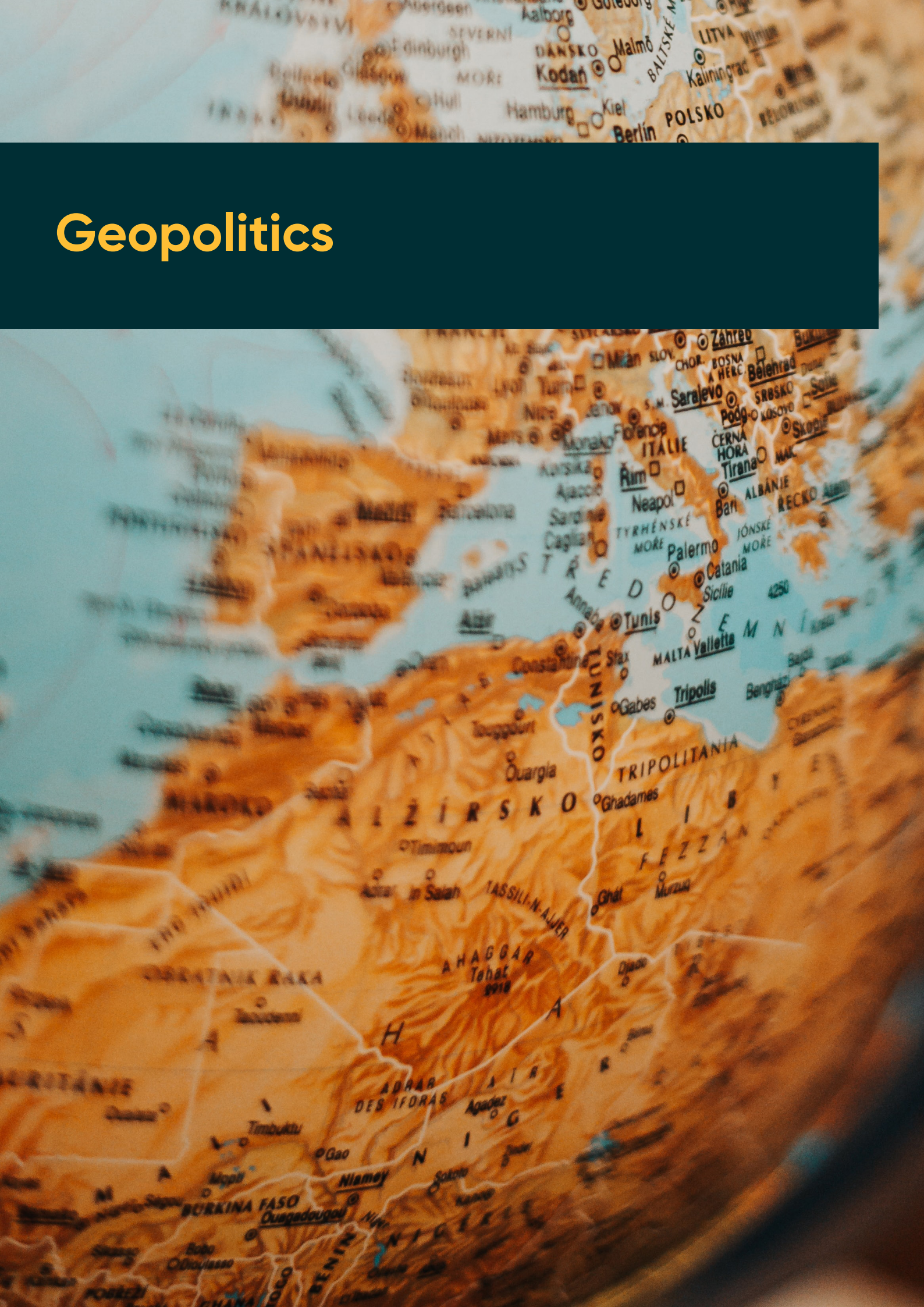
Contemplating China in more detail, its stated ambition to become self-sufficient in semiconductor manufacturing causes another raft of potential pitfalls that could seriously harm the continued growth of the market for semiconductor devices. An ideological battle of sorts is currently being played out between the USA that favours free-market economics, and the state-backed subsidising strategy of the Chinese government, wherein such Chinese subsidies artificially distort the industry by pumping money into favoured companies that lack the technology and know-how to challenge their US rivals – at least for now.

The aforementioned challenges are complex, even before considering the role of intellectual property. For some time, there has been a growing fear that innovation & R&D – the bedrocks of IP – could potentially be compromised as a result of the mutual distrust that exists between China and the USA; whether that be in relation to the theft of IP, the distortion of fair competition, the imposition of trade barriers, or other cyber-related warfare.

These are just some of the challenges that semiconductor companies and innovators presently face and we will explore each in-depth in the coming pages. And it is because semiconductors are so important to our current and future technological capabilities that these questions are now being asked and solutions offered.

Otherwise, in view of a global pandemic whose true repercussions are yet to be understood, added to the reality of an insatiable growth in demand, and a global supply chain that is precariously balanced, the semiconductor industry stands at a crossroads, where decisions made now could impact on all of our lives for decades to come.

Geopolitics



The Rise of China

For some time now, China has had its sights set on global supremacy in all facets of life and such sights of supremacy are no different in the semiconductor industry.

In 2015, the Chinese government announced its "Made in China 2025" national industrial strategy with a singular aim: to transform China from its current status as the world's workshop for manufacturing cheap goods facilitated by cheap labour, to a high-tech, highly-skilled manufacturing power that specialises in developing the technologies of tomorrow and that is totally self-sufficient.

Central to this Chinese strategy is an aim to dominate and master the dynamics of the semiconductor industry.

But what does this mean in practice?

China is currently the biggest consumer in terms of semiconductors purchases, accounting for over 50% of the global market share[3]. However, China is only capable of meeting 30% of its domestic demand. There are supply chain issues that in tandem with the "Made in China 2025" program, have driven the push to create a domestic market that can meet domestic demand as a priority – the program has targeted a figure of meeting 70% of domestic Chinese needs by year 2025.

The means for reaching this 70% target has seen the establishment of Chinese companies in the global semiconductor space – think of companies such as Semiconductor Manufacturing International Corporation (SMIC) and Zhaoxin. Their establishment has come about as a result of the guiding hand of the Chinese government who in 2014 established the National Integrated Circuits Industry Investment Fund, which raised $15 billion (USD) in its first financing round[4]. And the help does not stop there.

Tax breaks have been introduced that incentivise chip-making companies to import more of the manufacturing equipment and raw materials necessary for developing semiconductors.

Of course, these kinds of centralised plans are nothing new in China. However, the crucial difference with the "Made in China 2025" plan is the level of state intervention and cooperation with private companies, not only to expand the industry but also to acquire technical know-how.

Whether that is through the acquisition of intellectual property (legally or illegally) or forced technology transfer in return for access to markets, China is determined to relieve itself of its dependence on foreign suppliers and placate its rapidly expanding middle class, who now demand a superior level of luxury at a price point that only a domestic company can provide.

The New Cold War?

Such a bold industrial strategy was always likely to provoke consternation and a response from the USA and its allies, particularly in the semiconductor industry where the USA has always enjoyed a lion's share of revenues and technological know-how.

US companies are the leaders in this field of semiconductor technology – think of Intel, Nvidia, Micron Technology – and they account for 48% of the World's chip sales[5]. This overall trend shows no sign of declining, however the USA is beginning to lose dominance on the production side – semiconductor fabrication facilities located in the USA only accounted for 12% of the World's semiconductor manufacturing in 2020, down from 37% in the year 1990[6].

To reverse this trend, the Trump administration brought Intel and Taiwan Semiconductor Manufacturing Company (TSMC) to the table to discuss the development of new semiconductor fabrication facilities in the USA. Whether or not this will be successful remains to be seen, but the notion that the USA will not rise to the challenge laid down by China is unthinkable.

The Trump administration was particularly robust when it came to meeting their Chinese counterparts head-on.

What began as a boycott on Chinese telecoms giant Huawei in 2019, developed into blocking Taiwanese and South Korean companies from using American tools or knowledge to make anything to sell to Huawei unless they had a special license issued by the US government, thereby preventing the Chinese from accessing the latest semiconductor technologies; an area over which the U.S. has a virtual monopoly.

Relations further soured when in September of 2020, the US government placed sanctions on China's largest chipmaker, SMIC, citing military end-use in China. If the Chinese government thought the removal of Trump would precede better relations with the Biden administration, this looks highly unlikely as President Biden has already announced that he will be placing a further seven Chinese supercomputer companies on the US blacklist.

As well as challenging the growing influence of China in the semiconductor space, the USA has made its move to reassert its dominance in the knowledge side of the market. As part of a trillion-dollar stimulus package to get the US economy back on track following the pandemic, President Biden ring-fenced $50 billion (USD) specifically to be invested into the manufacturing and research of semiconductors.

This was followed by what can only be seen as a direct response to the "Made in China" 2025 plan, the Creating Helpful Incentives to Produce Semiconductors for America Act, or "CHIPS" as it is known. The Act is an all-encompassing piece of legislation that secured rare bipartisan support and included an investment tax credit of 40% for semiconductor equipment or facility costs, increased funding for technical education, military funding and better protections against foreign competitors.

This Act has helped to get US chipmakers back onside following a series of disputes with the government over their escalating trade war with China – the US chipmakers biggest market, after all. These companies rightly argued that access to Chinese markets, and the revenue that generated, was critical to them funding their astronomical R&D budgets which allows them to stay ahead of their competitors from an innovation perspective. This pushback resulted in a concession late last year when Qualcomm was granted a special license to sell some of its 4G chips to Huawei.

Taiwan: The Key to the Semiconductor Supply Chain

With this new cold war showing signs of heating up, the attention of each superpower has not just been fixated on the other, but also on a small island off the coast of eastern China, which represents the key to the entire global semiconductor market.

Taiwan has long been a strategic powder keg for both China and the USA, and the powder keg is on the verge of exploding.

But why has this situation arisen?

Taiwan and its leading chipmaker, TSMC, are the global leaders in chip manufacturing, responsible for producing 70% of the world's microchips. The semiconductor market value in Taiwan alone is estimated to be around $115 billion (USD)[7], and they have the distinct advantage of having near complete self-sufficiency in their supply chain. Self-sufficiency ranges from the technological know-how to an abundance of the foundries that produce chips for the world's leading chip-users: Apple, Qualcomm, Nvidia, and so forth.

Taiwanese semiconductor manufacturers are backed by a Taiwanese government that is keen to cement Taiwanese dominance in the field of semiconductors, with initiatives such as tax breaks, investment credits, the construction of science and industrial parks and a breadth of highly specialised companies that are home to some of the most advanced chip-making knowledge in the world[8]. TSMC recently announced a breakthrough in the development of semiconductor chips having 1-nanometer (nm) feature sizes, beating IBM to the punch[9] and showing that TSMC remains the benchmark for semiconductor innovation.

But while Taiwan enjoys the prestige and financial clout that semiconductor dominance has given it, the pressure of being such an out-sized player in the market and the strategic importance that comes with this is beginning to create problems.

These problems bring pressure that has undoubtedly intensified due to the pandemic. Disrupted global supply chains have increased our need for the chips that power our remote-working economies and are a bi-product of restrictions on movement associated with Covid-19. Add to this the ramping up of chip-heavy technologies such as 5G, autonomous cars and clean energy, and it is easy to see why there is a global shortage in semiconductors. TSMC now faces a perfect storm of a rapid surge in demand and a chokepoint in supply that has been exacerbated by the shadow of the trade war between China and the USA looming over them.

This trade war has had, and continues to have, significant ramifications on the dynamics of the semiconductor market. The USA has already taken steps to prevent Taiwan selling chips to China if the chips use American technology or materials in their manufacturing, and China has responded by stockpiling chips, thereby hastening the global shortage. In response, the USA is now seeking more collegiate relations with Taiwan based on the news that TSMC is exploring creating semiconductor manufacturing foundries in the USA, with a $12 billion (USD) foundry in Arizona being recently approved[10].

China's response has been similar. TSMC recently announced a $2.8 billion (USD) investment into installing cutting-edge production lines at an existing plant in Nanjing that will allow TSMC to scale up production[11].

With Taiwan seeing the USA as a more natural ally in terms of values, this has hardened China's resolve to become self-sufficient. This resolve is reflected in the moves being made by leading Chinese companies that rely on chips. Oppo and Xiaomi are working on their own in-house 5G chips, whereas Tencent is investing into an AI chip startup Enflame, Bytedance into its own cloud AI chips and ARM server chips, and Alibaba into AI cloud computing chips.

Of course, with such knowledge and manufacturing power, comes the reality that China and the USA now have a great interest in Taiwan and its critical semiconductor infrastructure. The geopolitics between the three powers is fraught with danger and Taiwan finds itself standing at a crossroads where it must decide between partnering with the dominant power in the market, the USA, or the fastest growing market and a menacing neighbour with historic territorial claims, China. Which path Taiwan chooses will have an enormous impact on the future of the semiconductor market worldwide.

Innovation

The Slow Death of Semiconductor Innovation?

For the past 50 years or so, the pace of semiconductor innovation has been unprecedented. This innovation is best understood by Moore's Law, a prediction by Intel co-founder Gordon Moore that the number of transistors that could fit inside a semiconductor chip would double every two years while at the same time, costs would halve.

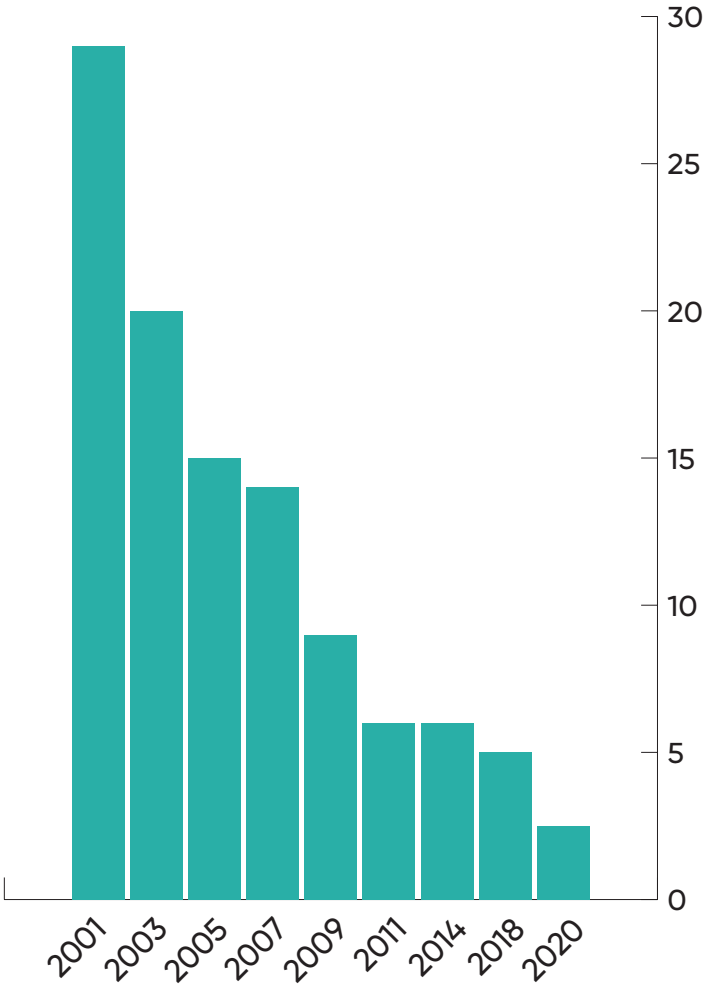
And this prediction has proved largely correct. The number of transistors per chip has increased by a factor of 10 million, which has increased processing speeds 100,000-fold, all the while driving costs down by 45% per year[12].

Such has been the progress and innovation in the design of chips, that we have reached a point in recent years where transistor sizes are being measured at the atomic level where quantum effects are beginning to be encountered.

But is this unstoppable innovation drive about to hit the buffers? Is Moore's Law reaching its endpoint in view of fundamental challenges in semiconductor device operation?

These questions are of course being driven by the belief that there is a limit to how small transistors can go, and that there would always be a natural slowdown in the rate of change that Moore's Law predicted. But there are other factors at play here that are contributing to a sense that innovation in semiconductors is facing a grave threat.

Number of leading-edge semiconductor processor-manufacturing firms



Data unavailable for all years
Source: The Economist

A Distorted Semiconductor Market

One of the main drivers of this fear has been the fallout from China's semiconductor industrial strategy having far reaching implications for innovation at every stage of the global supply chain.

With semiconductor policy a central pillar of the "Made in China 2025" strategy and the aim to become the global leader by 2030[13], it comes as little surprise that the Chinese government is funneling investment into the area of advanced semiconductor manufacturing technology.

The main vehicle driving this investment is the China Integrated Circuits Industry Investment Fund (CICIF) or the "Big Fund" as it is known in China, which raised $15 billion (USD) in its first round of fundraising with the help of banks and state-owned enterprises[14]. This investment was followed by another round of investment that raised a further $22 billion (USD) investment. The funding was directed at every stage of the semiconductor manufacturing value chain including manufacturing, design, packaging, testing, equipment and materials. The impact is already visible with China recently opening up a NASDAQ-style rival called the STAR Market, where tech companies are able to list, resulting in more semiconductor companies going public in China in years 2019 and 2020 than in the previous decade[15].

This is all well and good for China, but what kind of impact is this evolution having on the global market and the innovation that drives it?

Critics of the Chinese strategy say that it has grossly distorted the market. The critics argue that by picking favourites and giving them generous subsidies, the Chinese government is killing innovation by artificially boosting the standing of its semiconductor companies. A case in point: a semiconductor manufacturer in Wuhan found itself on the brink of going bust until the regional government stepped in and pumped $20 billion into a failing company[16] – hardly the sign of a healthy state of affairs. It may result in positive short-term outcomes, but longer-term, it creates inefficiencies, zombie companies with easy access to credit and directs investment away from more innovative domestic rivals.

Defenders of the strategy could point to the fact that, in many ways, China's strategy is no different to that of the USA; the development of public infrastructure, the tax incentives (China last year announced chip designers, packagers and testers will be exempt from corporation tax for the first two years they are profitable[17]), the investment in technical education, etc. The defenders also contest that this is a natural response to the USA that imposed sanctions that have hamstrung Chinese companies from becoming the dominant player in the semiconductor market and has forced them to build up their own infrastructure and capabilities.

The practice of subsidising is antithetical to the principles of innovation, which is a bottom-up, organic approach that is best realised in an arena of a competitive marketplace. A state-sponsored subsidy program as aforementioned tends to result in an uncompetitive landscape where losers are propped up and winners find their market share and value diminished.

Overcoming a Technical Deficit

However, such aforesaid subsidies go further than just making things less competitive. With China still lagging behind the USA and Taiwan from a technological standpoint, Chinese companies have been forced to poach and steal ideas and talent from others.

In certain areas, like the design of chips, China has made great strides and now has surpassed Taiwan in this field, but is still lagging behind the USA despite increasing its market share in this area from 4% in year 2004 to 43% in year 2019[18]. But this is an exception rather than the rule. Domestic companies still have tiny market shares and a lack of global presence when it comes to producing logic semiconductors that power central processing units (CPUs) and graphic processing units (GPUs), two areas that are still dominated by U.S. companies like Nvidia and AMD.

And in terms of the most advanced techniques, China is still playing catch up with even its European competitors. Dutch company ASML are considered market leaders in the development of extreme ultraviolet light (EUV), which has allowed them to utilise shorter wavelengths that allow for lithographically defining and etching smaller components.

These developments have forced the hand of the Chinese companies and their state backers who have begun a calculated program of hiring the best talent from their rivals, namely Taiwan in particular. Some of this hiring is an organic process that is the result of China being able to offer higher wages and other perks; however, it is easy to see the guiding hand of the Chinese government in facilitating this 'brain drain'.

Such measures have included: opening up routes to residency for Taiwanese immigrants, allowing Taiwanese investment in critical Chinese infrastructure such as 5G, and encouraging top Taiwanese graduates to work in China[19]. The result has been that since 2017, 3,000 of the 40,000 Taiwanese employed in semiconductor R&D have left for lucrative roles in China[20].

Of course, for Taiwan, this is a damaging blow that is compounded by the fact that as they lose their top talent, they also run the risk of trade secrets being given away. TSMC has its equipment manufacturers sign an agreement not to share trade secrets or sell any knowledge to China.

This can only go so far, and the Taiwanese government has responded in turn by strengthening their trade secrets laws and declaring that all cases involving the theft of intellectual property will be tried as cases of national security[21]. The end result of this continued poaching of talent is that innovation in Taiwan will suffer due to a loss of technological know-how and reduced R&D budgets, which as we will show, are essential to maintaining innovative practices.

The Rising Cost of Semiconductor R&D

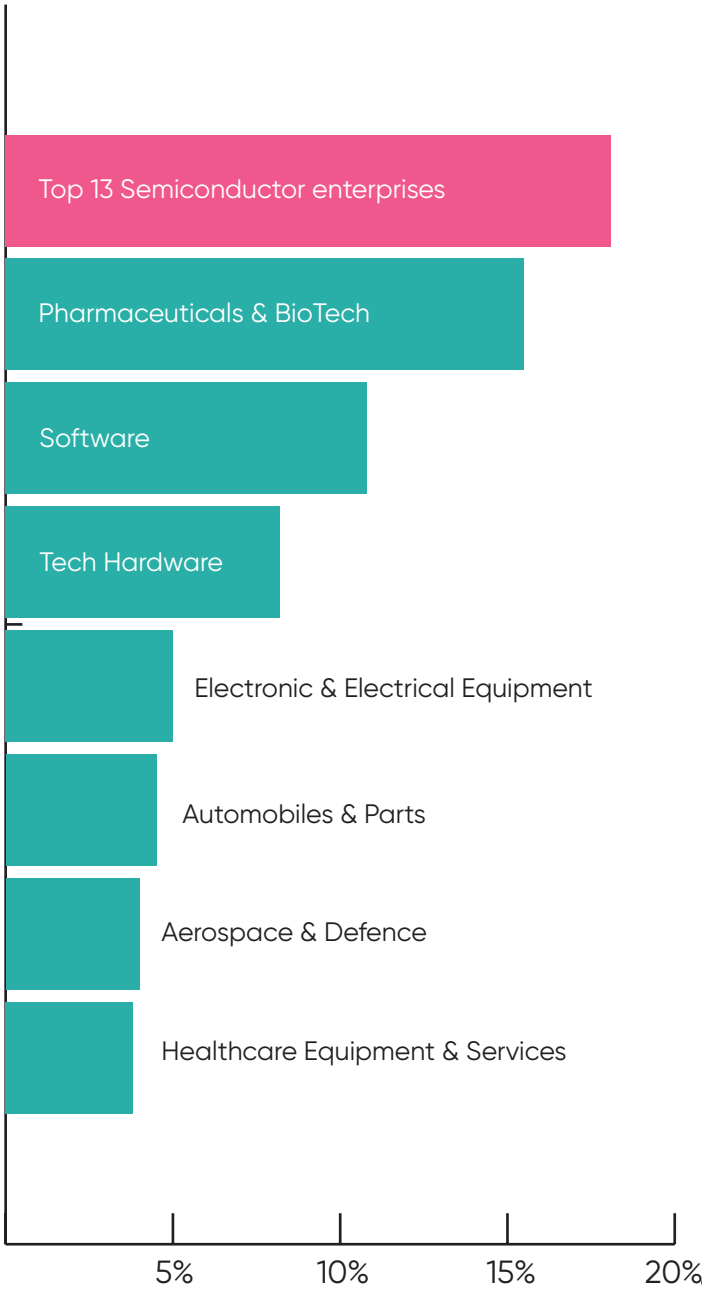
R&D investment is clearly critical to the continued success of semiconductor innovation. The extraordinary costs that are associated with creating semiconductors mean more money must be invested to try to find the solutions that will result in efficiency gains and therefore cost savings in future semiconductor products.

It is estimated that, despite the pandemic and severe cutbacks in spending, R&D spending by semiconductor companies will rise by 5% in 2021 when compared to 2020[22]. The reason for this is undoubtedly the need to stay ahead of the increased competition that China's drive for self-sufficiency has created, but also the fact that to achieve the gains that Moore's Law predicted, the number of researchers it takes is 18 times greater than the number in the 1970's[23].

And with this growing requirement for more manpower comes corresponding associated costs. Building a semiconductor fabrication facility alone is estimated to cost between $15 billion (USD) to $20 billion (USD), with reports estimating that there are only eight semiconductor companies currently able to afford such a cost[24]. And as features of semiconductors continue to shrink in size, the costs balloon at an astonishing rate. The jump in R&D costs from improving a 10nm minimum feature sizes on chips to 7nm minimum feature sizes on chips is $100 million (USD), and then from 7nm to 5nm minimum feature sizes on chips is $550 million (USD)[25] – this is before manufacturing, testing and packaging costs have even been factored in.

With demand for chips skyrocketing during the pandemic, the incentive to keep investing and innovating is undoubtedly there. So perhaps R&D spending is not under immediate threat. But problems will arise if supply chain bottlenecks and global tensions continue to persist and result in shortages of chips, which will lead to decreases in revenue and consequently, R&D budgets could be compromised as firms look to make cost savings to an already costly process.

Sector R&D intensity in the 2019 EU Industrial R&D Investment Scoreboard



Source: IFIT: Moore's Law Under Attack: The Impact of China's Policies on Global Semiconductor Innovation

Intellectual Property

Avoiding Semiconductor Intellectual Property Theft

Protecting against intellectual property theft has been a growing concern for some time now, particularly in the USA where many companies have fallen victim to foreign actors stealing their ideas and technologies. Because the semiconductor industry is so innovative, regularly vying with pharmaceuticals and biotech for this title of most innovative, the value of the intellectual property (IP) has gone up.

Recent examples of IP theft in the semiconductor industry are numerous. Taiwanese manufacturer UMC and state-owned Chinese company Fujian Jinhua were fined $60 million (SD) after pleading guilty to stealing trade secrets from US chipmaker Micron Technologies[26]. On occasions, there have been individuals as opposed to companies indicted; for example, a Chinese national was found guilty of stealing trade secrets from two US semiconductor companies, Avago and Skyworks, and passing them on to Tianjin University to help them build a new semiconductor fabrication plant. These and various other examples of theft of IP were instrumental in the US decision to impose sanctions on China and Taiwan.

There is also the issue of forced technology transfer, a policy China has promised to rein in, but continues to insist on, that is driving a wedge between itself and its trading partners. The policy, unofficial or otherwise, states that in return for access to markets, China demands that foreign companies reveal their technology secrets.

Many European and US companies claim they have been compelled to do so. In many cases, this forced technology transfer occurs in joint ventures – foreign companies working in tandem with domestic companies and being obliged to share patents, trademarks, copyright and trade secrets. While companies are not forced to enter into these joint ventures, the economic imperative to gain access to the world's second largest economy, is often too great a pull for many.

As a result of ongoing IP theft, governments and companies have come together to propose new means for defending trade secrets and tightening existing intellectual property frameworks to reduce a risk of theft of IP arising. Measures proposed to prevent theft so far have included increasing penalties and sanctions for the revealing of trade secrets, greater international cooperation between market leaders in cybersecurity and the beefing up of patent offices and other IP bodies[27].

But are these new means for defending trade secrets enough?

According to the CNBC Global CFO council, representing some of the largest US companies in various sectors, it is found that 1 in 5 of US companies has been a victim of IP theft at the hands of Chinese companies or state-owned enterprises and this is, according to the US IP Commission, costing $600 billion (USD) annually to the US economy[28]. As a result, relations between the two superpowers are mired in mutual distrust and a lack of cooperation that will only hurt future innovation in the semiconductor industry.

Intellectual Property Rights and the Semiconductor Market

All of this means that securing intellectual property rights (IPR) is, and will continue to be, the essential component that drives innovation and investment in the semiconductor industry.

Protection of ideas breeds confidence and confidence leads to continued investment in R&D. Think of intellectual property as the new arms race in the cold war between China and the U.S., with both sides building up their arsenal of intellectual property as a means for both attack and defence. With competition in the market growing and the stakes so high because of the financial gains to be made, patents and trade secrets must be of a high quality and must be robustly defendable.

Before examining the particulars of the patent system, it is important to recognise how IP is stolen. There are of course the obvious ways such as cyber-hacking, joint ventures, forced technology transfers, etc. But it can actually be far more insidious such as the acquisition of foreign companies to apply pressure to share ideas, hiring ex-employees of other semiconductor firms and investing in foreign companies that are conducting R&D in the field.

Then of course, there is the reverse engineering of semiconductor technology, a process that is very difficult to prove or stop from an IP standpoint. Discarded semiconductors can be reclaimed by precious metal vendors and categorised by them as hazardous waste, which means the waste must stay in the country. This can then be passed to a company with the manufacturing knowledge to exploit it by copying and rebuilding it[29]. The challenge is that reverse engineering has become an accepted part of semiconductor R&D and is even legally protected under the US Semiconductor Chip Protection Act of year 1984 which allows reverse engineering for "educational purposes" only[30]. This has led to reverse engineering departments being created within large semiconductor companies, whose primary work is to find cases of where their technology is being infringed upon, or where their patents could be enforced.

With China and the USA wary of the other in these respects, it was a welcome sign that in the Phase One trade deal between the two countries signed in 2020, China agreed to reform in the areas of intellectual property and technology transfer, as well as committing to buying more US goods and services[31]. The deal was seen as the Chinese admitting they needed to reform or face further tariffs or sanctions that would kill their drive to be self-sufficient in semiconductors.

There were a number of other intellectual property protections that were set out as part of this deal, in what was expected to be a comprehensive tightening of IP regulations. Measures such as expanding the definition of trade secret theft to include confidentiality breaches, ensuring criminal penalties for trade secret theft, creating a dispute resolution system that is fairer and faster, were all designed to prevent the need for further conflict.

The reality was not so simple. Since the deal was signed, the US government has imposed sanctions outlined earlier against TSMC and SMIC, meaning the rules proposed in the deal are yet to be truly enforced. This highlights the turbulent relationship between China and the USA, and proves that there is a long way to go for the two superpowers before they start cooperating and mutually respecting each other's intellectual property.

The Semiconductor Patent Market

The quickest and most effective route to securing protection for semiconductor companies is still the tried and tested patent. And the number of patents filed is still an important indicator of how innovative a company, or in the case of China and the U.S., a country is in a specific sector.

If we take this logic and apply it to the semiconductor industry, it reveals that the USA is the world's leading patent filer in semiconductors, with 29% of all patents filed in the sector originating from there according to the latest figures[32]. And while this share has been declining for the USA in recent years, the countries that have made up the gap are Japan, Taiwan, South Korea and the EU. China still lags behind all of these countries and is only responsible for 6% of the global semiconductor patents filed[33]. This number of patents is set to increase as China as a whole has slowly been increasing its own IP portfolio and as a result, will become more protective of it.

Because of its lack of patents and policies of subsidy and state intervention, China is said to be having a harmful influence on innovation for the rest of the world. It is estimated that the impact of these policies has resulted in 5,100 fewer US semiconductor patents being granted that would have otherwise been in 2019, based on Chinese companies receiving unfair advantages and their relative number of patents as a share of global sales[34].

Despite this lack of patents, this should, if anything, encourage semiconductor companies to file more patents with the Chinese office. The China National Intellectual Property Administration (CNIPA), is not as hostile as one may guess, with foreign plaintiffs winning more in damages and more often than local ones[35].

This of course means spending more to ensure the filing of all patents or trademarks is done by an expert with experience of the Chinese patent system and the Chinese language. But there are the added benefits that litigation costs are reasonably priced, the turnaround times are internationally competitive, and perhaps best of all, the courts are IP experts and judge rulings are considered reliable[36]. However, all of this knowledge is redundant without having an IP specialist with local knowledge and semiconductor expertise.

Away from China and looking more at the wider patenting process, drafting and enforcing semiconductor patents is challenging due to the intricate nature of the design process and the highly competitive state of the market. But as ever, understanding the technology has always been the key.

For those defending their semiconductor patents, proving infringement means showing that each element of the patent claim has been infringed upon. Because devices are so small, this makes actually analysing the product incredibly expensive and laborious. The machinery involved to carry out such a task may even be out of the reach of a company, due to its rarity. This is why it helps to have someone in your corner who knows the technology well enough to draft a patent where the novel step is not too hard to prove[37].

Semiconductor firms also need to consider that effectively defending a patent requires a strong knowledge of reverse engineering which is critical to be able to prove infringement of a patent and it is therefore worth investing in the best IP specialist available to ensure your technology stays on the market.

The Semiconductor Licensing Market

The rate of change in the semiconductor industry is also having a knock-on effect on the complexity of the licensing market. With so many companies involved in the making of a semiconductor, patents and licenses can be spread across the different areas of a company or between several companies with a stake in the market. This makes licensing complex but important.

Licensing has been a go-to method of protection for many semiconductor companies for some time now as it covers patents, technologies and designs. It also allows the many different stakeholders to speed up their entry to the market while ensuring they can monetise their intellectual property.

With the reality that semiconductor chips are increasingly specific to the device they end up in, companies do not have the time or resources to patent or protect each chip design. Instead, licensing allows them to accrue revenue by giving away existing designs that other companies can modify to build new chips. The popularity of licensing also reflects the pace of innovation in the semiconductor market, which is so fast that licensing an entire patent portfolio is a low-risk, low-effort way to protect ideas before knowing their true value.

Similarly, cross-licensing is very common in the semiconductor patent market. Arrangements can be wide-ranging and encompass multiple patents of varying strengths that act to complement another company's IP portfolio. These kinds of agreements tend to smooth relations between semiconductor companies as they can prove mutually beneficial if correctly applied.

Expert Insight

The level of integration achieved through several decades of pushing the limits of Moore's law has pushed the price per transistor to such a low level where the field is opportunity-rich and imagination and innovation needs to be unleashed.

The advancement of technology in the semiconductor industry is at the core of the digital transformation.

As new applications continue to emerge like: AI, cryptocurrency, 5G, which are not bound by geographical frontiers; intellectual property will play a critical role to protect market share.

The elevated system complexity will continue to push the market to a place where licensing is the norm.

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Endnotes

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Next Steps

To find out more about how Aalbun can give your semiconductor company peace of mind that their ideas are protected through our secure platform, request a demo or speak to our team.

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About Aalbun

Aalbun is the World's first Intellectual Property Platform as a Service (PaaS).

In essence, Aalbun is a single pane of glass to request and service all your intellectual property requirements through our secure WorkZone platform.

Aalbun is powered by a global network of experts who, between them, can provide high-quality work, at pace, across any market.

Aalbun was founded in Cambridge, UK, in year 2014 and was incubated at ideaSpace, at the University of Cambridge. The joint experience of our three founders, Christian, Tim and Janne, amounts to over 65 years of working within intellectual property procurement; the creation of 250+ patent families as inventors, and the development of 11 new ventures.

Today, we have an outstanding team spread across the UK, USA, Australia, Brazil, Denmark, Finland, Sweden, Poland and India.

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