Would Huawei's operation's plan of production of their own chips after the trade ban a good financial investment?

Intended Audience: Huawei

Candidate Number: xxxxxxx

Word Count: 1500

IB Business and Management

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Introduction

Huawei, founded in 1987 by Ren ZhengFei, is the leading global provider of information and communications technology (ICT) infrastructure and consumer electronics (Huawei). Huawei currently operates in more than 170 countries providing more than 3 billion people with products and services. (Huawei)

On May 16th of 2019, US places Huawei on its "entity list", banning it from making any transactions with US companies. Huawei was not affected by this ban as most of their chips were manufactured by Taiwan's Taiwan Semiconductor Manufacturing Company (TSMC). TSMC supplied over 90% of Huawei's smartphone chips in 2020 (Kharpal). However, one problem was that TSMC manufactures chips for Huawei using chip making equipment from the US. On May 16th 2020, a new law was enforced by Washington which requires foreign manufacturers using US chip making equipment to get a license before being able to sell to Huawei. (Kharpal) This policy indicated that Huawei would no longer be able to use TSMC as their manufacturer. They would need to find new ways to diversify their supply chain. (Kharpal) This policy would heavily affect the consumer division which yielded over 50% of the company's total revenue in 2019 and brought in $66.93 billion in sales (Kharpal).

Huawei is now deciding whether they start its own production line, or, alternatively, use other manufacturers.

Methodology

This essay will be focusing on the finance section of the IB Business Management course, specifically investment appraisal. I used break-even analysis, Ansoff's matrix, and SWOT analysis to explore my research question. These tools were chosen as it help illustrate Huawei starting their own production line from different aspects: price, external factors, internally factors, risk. Production price of microprocessors were taken from secondary sources that specialize in breaking down phones and calculating the pricing of each component. However, due to having limited access, I was not able to get data on some microprocessors mentioned, therefore I made education estimations, pricing it similarly to chips of the same caliber and the same technology. This will create some uncertainty with calculations, but it should be relatively accurate.

Commentary

Huawei is praised for its Kirin line of phone CPU chips. Due to the new US policies, Huawei needs to find a new way of these high-end phone chips in bulk.

Using other manufactures

First, we can consider Chinese manufacturers, the most notable being China's Semiconductor Manufacturing International Corporation (SMIC). SMIC is an option that Huawei is currently exploring. SMIC has been reported to have started production of Huawei's lower end chips. (Byford) However, it is no secret that SMIC is behind in terms of technology when compared to TSMC. Neil Shah, the research director at Counterpoint research was quoted saying "TSMC is miles ahead of SMIC in terms of leading-edge technology prowess, capacity and scale."

(Kharpal) Huawei's high-end chips are based the 7 nano-meter technology which SMIC has not yet been able to implement. This may mean that Huawei can only rely on SMIC for lower end chips. An example would be the Huawei Mate 10, a high-end phone released two and a half years ago. It uses the Kirin 970 developed by HiSilicon three years ago. According to Techinsights cost breakdown analysis, a Kirin 970 chip costs Huawei $51.7. (Cowsky) With a combined production cost of $290, the Huawei Mate 10 goes at a retail price of $750. Huawei Mate 10 has a return rate of:

$$\frac{750}{290} = 258\%$$

Since the Huawei Mate 10 with all the components combined has a return rate of 258%, we will assume that the chip itself also has a return rate of 258%. This means that each chip is sold at $133.40. In just year, the Huawei Mate 10 reached 10 million sales worldwide. (Artashyan) This would give Huawei a gross profit of:

$$133.4(10{,}000{,}000) - 51.7(10{,}000{,}000)$$

$$= \$817{,}000{,}000 \text{ (Microprocessors only)}$$

With more advanced chips, Huawei can consider using Samsung as their chip manufacturer. Samsung possess the cutting-edge equipment needed to produce the new chips as the Kirin 790. (Kharpal) Kirin 790 has an estimated production cost of $75. The Mate 30 pro, which utilizes the Kirin 790, has an estimated production cost of $425 and a starting price of $1215. (Eschulze) But since Samsung is a manufacturer located in South Korea, we must take into consideration the tariff fees that will be charged upon entry of China. According to Custumdutyfree.com, processors has a tariff of 40%, making the total cost per chip:

$$75 + (75 \times 0.4) = \$105$$

(DutyFree)

It was announced on Weibo by a reporter that Huawei's Mate 30 series has exceeded 10 million sales. (千年) If we continue to assume that the return rate of the CPU is equal to the return rate of the phone (without tariffs)

$$\frac{1215}{425} = 296\%$$

We can assume that the Kirin 990 has a selling price of:

$$75 \times 2.96 = \$210.75$$

So, the gross profit of 10 million sales of the Mate 30 Pro would equal to:

$$10{,}000{,}000(210.75 - 105)$$

$$= \$1{,}057{,}500{,}000 \text{ (chips only)}$$

Huawei producing their own chips

The last option Huawei has is that they can start their own production line. This would be considered the growth strategy diversification; Huawei would be entering a new market with a new product.

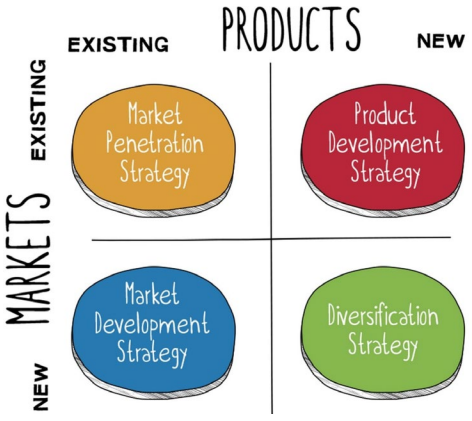


Figure 1. Diagram of the Ansoff matrix

(Bhasin)

Diversification is extremely risky and requires a large amount of startup capital, however if it succeeds, it has an extremely high growth potential and profitability.

To implement this, Huawei will first need to purchase semiconductor equipment.

Strengths	Weaknesses
• Lower variable cost • Makes operation's more efficient • Machines can work 24/7 • Better long term cashflow • Don't have to pay tariffs • Remove all reliance on the US / external sources • Helps solve the problem of not being able to reliably produce high-end chips	• Needs maintenance • Very high initial cost • Requires workers with specialized knowledge on how to operate the machines • Machine breaking/failing • High electricity/power costs • high payback period • Implementation time
Opportunities	**Threats**
• Demand from other companies for chip production • Positive press coverage, betters brand image and increase patriotism	• Microproccers getting more and more advanced, may have to upgrade equipment • Pressure from the US

Figure 2. SWOT analysis of implementation of semiconductors

Figure 2 demonstrates the strengths, weaknesses, opportunities, and threats of investing in semiconductor equipment.

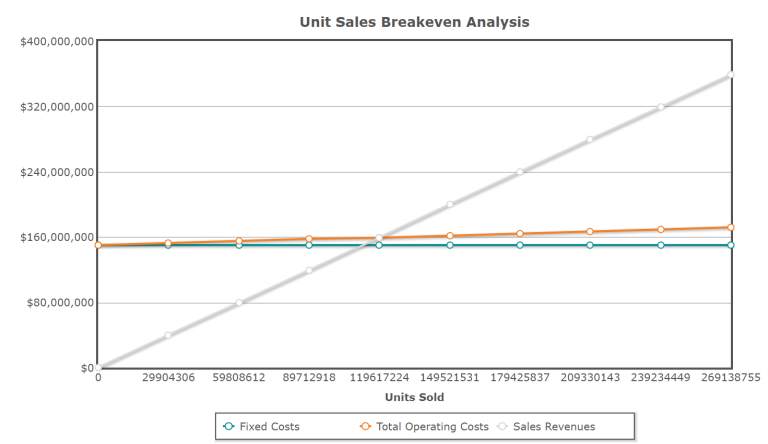


Figure 3. Break even analysis of Kirin 970 chips

GlobalFoundaries invested $15 billion to build a chip factory that had the capabilities of 7 nano-meter technology, Huawei must do the same. (Takahashi) The variable cost, however, in comparison to the fixed cost, is much cheaper at an estimated $8 per chip.

From figure three, we can see that Huawei must sell 119,617,224 Kirin 970 chips to break-even. But once Huawei breaks even, they will have a return rate of $\frac{133.4}{8} = 1668\%$ and would take them less than $817{,}000{,}000 \div (133.4 - 8) = 6{,}515{,}152$ total sales to reach how much they made with 10million sales using chips from suppliers.

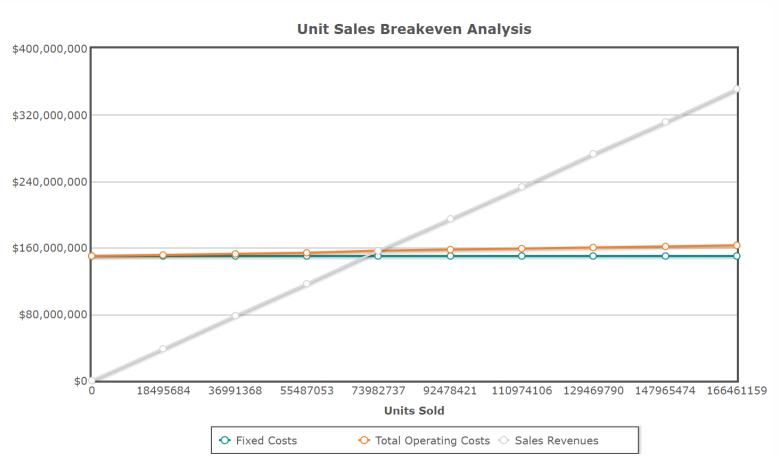


Figure 4. Break even analysis of Kirin 990 chips

Figure four shows that Huawei needs to sell 73,982,737 Kirin 990 chips to break-even. But once they break-even, they will be earning a gross profit of $\$205.75$ per chip which is $100 more than purchasing from supplier. This significant increase in profit margin makes it the better option in the long term.

According to Forbes.com, Huawei sold a total of 240 million phones in 2019. (Sin) If we estimate the average gross profit of a single chip to be $100, we will be able to calculate the payback period of this investment (only chips).

$$15{,}000{,}000{,}000 \div 240{,}000{,}000(100)$$

$$= 6.25 \text{ years}$$

However, it is more than likely Huawei would use profits earned from other components or their telecommunication services to payback the cost of this investment. Therefore, the payback period should be significantly less. I have also not considered factors such as employee training and device maintenance which can increase the cost of this investment and increase the payback period.

Conclusion

To conclude, Huawei's plan of producing their own chips would be significantly better in the long term and remove their reliance on US/other companies, whereas, using suppliers would be better for Huawei's short term cashflow, especially during a time of uncertainty with COVID and the trade war. Both options have their up and downs, ultimately, it comes down to what Huawei wants.

Using manufacturers would allow Huawei to continue to operate the way they do normally. This makes it low risk as the way in which Huawei operates has proven to be very effective. However as mentioned, the options Huawei have are not the most advanced in chip research and may hinder future products. If Huawei is unable to keep up with in the future in chip performance, Huawei will lose out on an immense amount of market share as the microprocessor is the most crucial part of a mobile phone and it is one of Huawei's biggest unique selling points.

If Huawei's goal is to make sure external problems will not affect their production again and regain their top spot for sales, diversifying to produce their own chips is the way forwards. large investment initially needed is troublesome, however, if Huawei manages to break-even, their profit margins would increase by an immense amount and give them more capital to better promote their products overseas where they have a bad reputation and allow them to thrive in the future. They will also be able to sell their products at lower prices, drawing in price sensitive customers. One last factor to consider is as processors become more advanced, it may mean

that machines may need to be replaced. This means that Huawei may have to invest in new machinery or upgrade their machinery once every few years.

Another option that Huawei can consider is investing in 7nm semiconductor equipment as a short–mid-term solution. Once the machines are outdated, hopefully Huawei would be removed from the “entity list” and they would be able to use services from TSMC again, or, SMIC would then have access to advanced equipment. Huawei would then be able to get the new chips from manufacturers without another hefty investment in machines. They would still be able to use their machines as a mean for them to develop their 7nm chips, cutting costs and increasing profit margins.

Appendices

Supporting document 1:

Why new U.S. rules on selling chips to Huawei could be a ‘big blow’ for the Chinese tech giant

PUBLISHED MON, MAY 18 20201:29 AM EDTUPDATED MON, MAY 18 20207:59 AM EDT

The United States’ latest move to restrict chip sales to Huawei could be a big blow to the Chinese technology giant, hitting its two biggest businesses and offering very little wriggle room for the firm to find alternative suppliers.

Billions of dollars of revenue are at risk from Washington’s latest rule which requires foreign manufacturers using U.S. chipmaking equipment to get a license before being able to sell semiconductors to Huawei. There is no indication that the U.S. will grant licenses either.

Huawei said in its first comments on the issue that it “categorically opposes” the U.S.’s chip regulation.

“Nevertheless, in its relentless pursuit to tighten its stranglehold on our company, the U.S. government has decided to proceed and completely ignore the concerns of many companies and industry associations,” the company said in a statement.

“This decision was arbitrary and pernicious, and threatens to undermine the entire industry worldwide. This new rule will impact the expansion, maintenance, and continuous operations of networks worth hundreds of billions of dollars that we have rolled out in more than 170 countries.”

It added that its business “will inevitably be affected.”

Washington’s latest rule will give it power in determining what semiconductors Huawei can get its hands on.

“The US government will have full global authority in interpreting what chip items Huawei will be able to access going forward,” China Renaissance said in a note published Monday.

That’s a big deal. Chips are critical for a huge swathe of Huawei’s products from its base stations required for 5G networks to its smartphones. Huawei designs semiconductors for its products via a division of the company called HiSilicon. But the actual manufacturing of those chips is done by Taiwan’s TSMC, one of the companies that stands to be most affected by the new U.S. rules. TSMC uses American-made equipment to manufacture those chips.

For its smartphones, Huawei has a series of processors under the brand name Kirin which goes into almost all of its smartphone models. The problem for Huawei is its huge reliance on TSMC with over 98% of smartphone-related chips manufactured by the Taiwanese firm, according to an estimate by Counterpoint Research.

Huawei's consumer division accounted for over 50% of the company's total revenue in 2019 and brought in 467.3 billion yuan ($66.93 billion) in sales. There is a lot of money at stake if this business unit is hit.

Diversifying is a 'humongous ask'

So, what are Huawei's options? Well, it needs to find a way to diversify its supply chain, a task that could prove difficult given the wide-ranging impact of Washington's new rules.

Huawei has been looking to do this over the past year. In March, Tim Danks, a U.S.-based Huawei executive told Bloomberg the company sold 50,000 5G base stations that did not contain U.S. technology. At the time, that number was only 8% of the total number of 5G base stations Huawei had sold globally. A base station is a piece of equipment critical to mobile networks. 5G refers to next-generation network infrastructure that promises super-fast download speeds and the ability to underpin key infrastructure.

Meanwhile, Huawei has been looking at mainland Chinese chipmakers to produce its Kirin processors for smartphones. SMIC, China's largest contract chip manufacturer, is the number one contender.

State-backed publication Global Times reported last week that SMIC had begun mass production of Huawei's Kirin 710A chip. This processor is designed for a lower tier phone under Huawei's budget Honor brand. This chip is only for one device and does not solve Huawei's problems for the rest of its product portfolio.

Huawei declined to comment on the Global Times report.

On top of that, "TSMC is miles ahead of SMIC in terms of leading edge technology prowess, capacity and scale," according to Neil Shah, research director at Counterpoint Research, who added the new U.S. rules could be a "big blow" for Huawei.

Huawei's flagship chip, the Kirin 990, is based on so-called 7-nanometer technology. This essentially refers to the size of certain aspects of the chips. These 7nm chips are smaller and faster than predecessors.

TSMC has been producing these for around two years. It's unclear when SMIC may introduce a 7nm production process at scale. So even if Huawei

wanted to switch production to SMIC, the chipmaker might not be able to actually produce those parts.

SMIC was not immediately available for comment when contacted by CNBC.

TSMC has already halted taking new orders for chips from Huawei, the Nikkei Asian Review reported on Monday, citing unnamed sources.

“It is market rumor, and TSMC does not disclose customers’ order details,” a spokesperson for the company said.

Huawei could look to Samsung’s chip manufacturing business to make the semiconductors required as an alternative to TSMC. However, Samsung is “currently Huawei’s biggest competitor and so it would rather push a domestic supplier than a rival company which is South Korean and technically a U.S. ally,” Shah told CNBC.

That leaves Huawei in a very tough position.

“So from Huawei’s perspective, it will help to quickly look to diversify its supply chain further into a non-U.S. tech-based supplier list which is a humongous ask in the short-to-mid-term. Most of the companies which supply advanced components have some or the other form of (U.S.) equipment or technology being indirectly used,” Shah said.

Supporting document 2:

Cost Comparison – Huawei Mate 10, iPhone 8, Samsung Galaxy

Posted: November 1, 2017, Updated: November 6, 2017

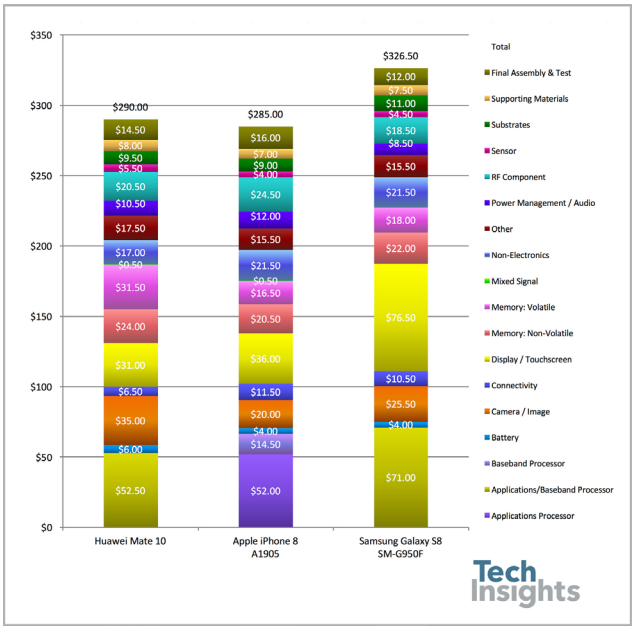
Contributing Authors: Al Cowsky

While Apple and Samsung have been engaged in a tug-of-war for the title of top-selling smartphone provider over the past couple of years, China's dominant OEM - Huawei - has been quietly gaining traction globally with their P- and Mate-series offerings.

TechInsights has conducted in-depth an analysis of each provider's most recent contenders:

- Apple iPhone 8
- Huawei Mate 10
- Samsung Galaxy S8

Our reports provide our complete details of each phone, and our various tools provide a number of ways to slice and dice and compare data about them; here, we are providing a summary cost comparison of the three phones.



Cost Comparison Observations

	Huawei Mate 10	
Teardown Date	October 2017	
Applications Processor	–	

	Huawei Mate 10	
Applications/Baseband Processor	$52.50	
Baseband Processor	–	
Battery	$6.00	
Camera / Image	$35.00	
Connectivity	$6.50	
Display / Touchscreen	$31.00	
Memory: Non-Volatile	$24.00	
Memory: Volatile	$31.50	
Mixed Signal	$0.50	
Non-Electronics	$17.00	
Other	$17.50	
Power Management / Audio	$10.50	
RF Component	$20.50	
Sensor	$5.50	
Substrates	$9.50	
Supporting Materials	$8.00	
Final Assembly & Test	$14.50	
Total	**$290.00**	

** Costing note: All cost estimates provided here are compiled using information available to us at the time of the initial teardown. Some assumptions have been made where concrete data is not yet available. We will continue to gather and refine this costing data throughout our on-going deep-dive teardown process and analysis. While we do not expect drastic cost changes, we do expect some adjustments.*

Application Processors

The Applications Processors of the phones appear to be categorized inconsistently in the table above; this is intentional, based on the different components that combine to provide the functionality.

Phone	Applications Processor Components	Cost of Components
Huawei Mate 10	Kirin 970	$51.70
Apple iPhone 8	A11 Intel PMB9948P LTE modem	$51.96 $14.26
Samsung Galaxy S8	Samsung Exynos 9 (Exynos 8895)	$71.00

Street price compared to manufacturing cost

Apple and Huawei have very similar parts costing models, whereas the estimated parts cost of the Samsung is significantly higher.

	Huawei Mate 10	Apple iPhone 8 (A1905)	Samsung Galaxy S8 (SM-G950F)
Street Price	$710.00	$699.00	$725.00
Parts Cost	$290.00	$285.00	$326.50
Representative Cost of Parts	40.8%	$40.8%	45.0%

Supporting document 3:

Huawei hits back at US as TSMC cuts off chip orders

"The US government still persists in attacking Huawei, but what will that bring to the world?"

By Sam Byford@345triangle May 18, 2020, 4:41am EDT

Huawei rotating chairman Guo Ping has hit back at the US government's stricter export controls intended to stop the Chinese tech giant from obtaining essential chips, following reports that its biggest supplier has already cut it off. "We still haven't figured it out," Guo said on stage at Huawei's annual analyst summit. "The US government still persists in attacking Huawei, but what will that bring to the world?"

"In its relentless pursuit to tighten its stranglehold on our company, the US government has decided to proceed and completely ignore the concerns of many companies and industry associations," Huawei adds in an official statement. "This decision was arbitrary and pernicious, and threatens to undermine the entire industry worldwide. This new rule will impact the expansion, maintenance, and continuous operations of networks worth hundreds of billions of dollars that we have rolled out in more than 170 countries."

"We expect that our business will inevitably be affected," Huawei's statement continues. "We will try all we can to seek a solution."

Nikkei reported earlier today that TSMC has moved to stop new orders from Huawei following the US government's announcement last week. The rules are specifically designed to target Huawei and its chip subsidiary HiSilicon, requiring a license for any shipments from manufacturers that use US technology or equipment. TSMC didn't deny the reports but called them "purely market rumor," according to Reuters.

Huawei has in the past suggested that it could switch its chip supply to Samsung in this eventuality. The company has also recently been exploring domestic chip production through China's Semiconductor Manufacturing International Corporation (SMIC), which just received a $2.2 billion investment from the Chinese government.

“THE US IS LEVERAGING ITS OWN TECHNOLOGICAL STRENGTHS TO CRUSH COMSPANIES OUTSIDE ITS OWN BORDERS.”

SMIC is a relatively tiny competitor to TSMC, however, and it would take a long time to scale up to Huawei’s cutting-edge demands. Last week SMIC started mass production of HiSilicon’s Kirin 710A processor on its 14nm node, but TSMC is expected to move onto a more advanced 5nm process this year. Even the original Kirin 710 was manufactured by TSMC at 12nm, and that was a mid-range chip in 2018.

“This decision by the US government does not just affect Huawei. It will have a serious impact on a wide number of global industries,” Huawei says in its statement. “In the long run, this will damage the trust and collaboration within the global semiconductor industry which many industries depend on, increasing conflict and loss within these industries. The US is leveraging its own technological strengths to crush companies outside its own borders. This will only serve to undermine the trust international companies place in US technology and supply chains. Ultimately, this will harm US interests.”

Richard Yu, CEO of Huawei’s consumer division, also spoke out against the US government today. “The so-called cybersecurity reasons are merely an excuse,” he wrote in a WeChat post reported on by Bloomberg. “The key is the threat to the technology hegemony of the US.”

Supporting document 4:

Why the $10 billion chip factory club just got smaller

August 28, 2018 11:35 AM

Globalfoundries was creating a 7-nm chip factory. Now it will shift to other nodes.Image Credit: Globalfoundries

It takes about $10 billion or even $15 billion to build a brand new state-of-the-art chip manufacturing plant, and only a few companies in the world can amass the kind of expertise and capital to do it. Globalfoundries admitted yesterday it would no longer invest in a bleeding-edge 7-nanometer fabrication plant, or fab. Advanced Micro Devices said at the same time that it would switch from Globalfoundries to TSMC to build its latest high-end processors.

Globalfoundries will instead focus on making investments in older 14-nanometer and 12-nanometer factories (a nanometer is a billionth of a meter, and the number refers to the distance between circuits), which require less upfront investment and carry a far smaller burden of technology development. That means that just a few companies — TSMC, Intel, and Samsung — are still in the race to build 7-nanometer chip factories.

“Globalfoundries was falling further and further behind, so AMD really had no choice but to switch,” said Linley Gwennap, analyst at the Linley Group. “Also, AMD has been using TSMC for years to build its graphics chips, so they already have a strong relationship.”

This is all happening against the backdrop of changes in Moore’s law, the prediction made in 1965 by Intel chairman emeritus Gordon Moore that the number of transistors on a chip will double every year. The chip industry has been on the metronome of Moore’s law for decades, and that progress has delivered computing power in a smartphone that once took a whole room of computers. Intel executives say that if every industry had moved forward on the same line as the chip industry has, we would be able

to travel to the sun on a single gallon of gas, feed the world's population on a square kilometer of land, and travel at 300 times the speed of light. If you feel like technology has been moving along at an accelerated pace, it's not your imagination. It's because of Moore's law.

Above: Inside Globalfoundries' 7-nm chip factory.
Image Credit: Globalfoundries

But Gordon Moore himself has said in the past that he believed that we would hit an economic barrier to Moore's law before we hit a technological one. The technological barrier may be at hand as well, as even chip manufacturing giant Intel had to delay mass production of its 10-nanometer chips (due to a difference in naming conventions, Intel's 10-nanometer chips are the equivalent of 7-nanometer chips from its rivals) until 2019. The task of making chips at smaller and smaller dimensions is getting difficult as engineers run into the laws of physics and the behavior of individual atoms in less than razor-thin manufacturing layers.

At the dawn of chip factories in the 1950s and 1960s, almost every Silicon Valley chip maker created its own chips in factories. They built wafer fabs in Silicon Valley, and then offshored the assembly of the wafers into individual chips to places where labor costs were lower. The rising manufacturing costs went hand-in-hand with greater throughput, so each chip factory could make more revenue. But amassing the capital for a new factory became huge.

That trend led to the rise of foundries, or contract manufacturers who took the designs of "fabless" companies and built them in factories. TSMC was founded in 1987. At first, it saw rising competition as demand for foundries rose, but now many of its rivals have dropped out due to the rising capital costs. And that's where we are today. It's perhaps no wonder that TSMC's market value exceeded Intel's for the first time in March 2017. Today, Intel is valued at $223 billion, and TSMC is $211 billion.

Dan Hutcheson, analyst at VLSI Research, said that Globalfoundries' decision to skip 7-nanometer will allow the company to focus on fully depleted silicon-on-insulator, where it has a unique advantage for chips that require features such as low power, radio frequency, and things needed for other chip markets.

"It simply didn't make sense for them to continue playing in the me-TSMC-too poker game, where the house always has the advantage," Hutcheson said in an email. "AMD has a long history of working with TSMC that dates back to their entry, via acquisition, into GPUs."

He aadded, "As for cost to build a fab, it's now at $15 billion heading to a cool $20 billion. The problem isn't capital as much as it is finding the people who know what they're doing at the leading edge."

For AMD, the switch to TSMC required some foresight, as the company had to go to the trouble to make sure that its processor designs could be manufactured in TSMC's factories as easily as they could be built in Globalfoundries' factories.

"Since I consider TSMC 7-nanometer to be in the same class as Intel 10-nanometer (and thus better than Intel 14-nanometer), AMD will actually have superior transistors than Intel until at least late next year. Who would have thought?" said Gwennap.

For AMD, there is some risk in going to a single source at TSMC to make its chips. TSMC will have to scramble to ensure enough capacity to build AMD's chips and serve its existing customers as well. But the switch will likely simplify AMD's engineering work, as TSMC already makes AMD's Radeon graphics chips.

"AMD had to make a call to keep pace with bleeding-edge process nodes and TSMC had the lead. I'd guess Globalfoundries just couldn't scale big enough to pay for the 7-nanometer development costs without AMD as a customer — possibly even with AMD as a customer," said Kevin Krewell, analyst at Tirias Research.

In other news, the head of AMD's computing and graphics division, Jim Anderson, took a job as CEO at Lattice Semiconductor on Monday. But Gwennap didn't see the latest departure as a huge problem for AMD, which has a strong talent bench

Bibliography

Huawei. “About Huawei.” *Huawei*, 13 Mar. 2020, www.huawei.com/en/about-huawei#:~:text=Who%20is%20Huawei%3F,a%20fully%20connected%2C%20intelligent%20world.

Kharpal, Arjun. “Why New U.S. Rules on Selling Chips to Huawei Could Be a 'Big Blow' for the Chinese Tech Giant.” *CNBC*, CNBC, 18 May 2020, www.cnbc.com/2020/05/18/huawei-faces-big-blow-from-new-us-rules-to-cut-off-chips.html.

Eschulze. “Huawei Unveils Its New 5G Flagship Phone without Google-Licensed Apps.” *CNBC*, CNBC, 19 Sept. 2019, www.cnbc.com/2019/09/19/huawei-mate-30-announced-specs-price-android.html#:~:text=The%20lineup%20includes%20the%206.62,cost%201%2C199%20euros%20(%241%2C326).

Cowsky, Al. “Cost Comparison – Huawei Mate 10, IPhone 8, Samsung Galaxy S8.” *TechInsights Inc.*, 26 Aug. 1970, www.techinsights.com/blog/cost-comparison-huawei-mate-10-iphone-8-samsung-galaxy-s8.

Dutyfree, Customs. “Customs or Import Duty for Cpu to China.” *CustomsDutyFree*, 23 Sept. 2017, customsdutyfree.com/customs-or-import-duty-for-cpu-to-china/.

千年 . *网传华为Mate30 系列销量已破 1000 万 麒麟990 处理器研发成本完全收回*, 4 June 2020, mobile.yesky.com/283/708331783.shtml.

Sin, Ben. “Huawei Still Sold More Phones Than Apple In 2019, But Admits 2020 Will Be 'Difficult Year'.” *Forbes*, Forbes Magazine, 31 Dec. 2019, www.forbes.com/sites/bensin/2020/12/30/huawei-still-sold-more-phones-than-apple-in-2019-but-admits-2020-will-be-difficult-year/#4ccc57c81d8f.

Bhasin, Hitesh, et al. “Ansoff Matrix Theory Examples of Business Strategies for Future Growth.” *Marketing91*, 30 Nov. 2019, www.marketing91.com/ansoff-matrix/.

Takahashi, Dean. “Why the $10 Billion Chip Factory Club Just Got Smaller.” *VentureBeat*, VentureBeat, 28 Aug. 2018, venturebeat.com/2018/08/28/why-the-10-billion-chip-factory-club-just-got-smaller/.

Byford, Sam. “Huawei Hits Back at US as TSMC Cuts off Chip Orders.” *The Verge*, The Verge, 18 May 2020, www.theverge.com/2020/5/18/21262042/huawei-us-export-tsmc-chip-manufacture.

Artashyan, Argam, et al. “Huawei Mate 10 Shipped Over 10 Million Units.” *Gizchina.com*, 3 Aug. 2018, www.gizchina.com/2018/08/03/huawei-mate-10-shipped-over-10-million-units/.