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Make Vs. Buy: OEMs Now Have A Choice For Semiconductors

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A number of years ago I authored an article about the make-vs-buy decision design engineers face in obtaining power supplies for their projects. Due to the ongoing interest in the topic, I recently wrote an update. This article has remained popular because the topic is forever relevant in electronics engineering. System designers are continually faced with the question of whether to make or buy the power supply circuitry they need, while at the same time there are always new options for designing and purchasing power supplies.

Today, some engineers and their companies face a similar question about semiconductors—should we buy them or make them? Here, I have reversed the order of the question because while the default with power supplies was originally for system designers to design and build them, the default with semiconductors has long been to buy them from dedicated semiconductor companies.

However, with large OEMs now having the engineering talent and design tools to create their own ICs, and have them fabricated by foundry companies, make or buy is now a relevant question for semiconductors. The recent unprecedented component famine of 2019 to 2023, which greatly affected the supply of semiconductors, has disrupted supply chains dramatically and cost OEMs millions in lost opportunity. This has driven major companies to take matters into their own hands.

This article looks not so much at the issue of how companies determine whether to make or buy their semiconductors, but rather how trends in the industry are pushing them toward the "make" decision. To understand how the industry got to this point, we need to look back at where the semiconductor business was in decades past and how it has evolved.

The Business Cycles

The semiconductor industry has always been highly cyclical. The first semiconductor cycle I experienced was in 1984 while working as an FAE at Analog Devices. That year, the industry went from normal lead times to 45 weeks to "who knows when?" Subsequent cycles from feast to famine have been the hallmark of the semiconductor industry.

Despite the obsession every semiconductor company has with forecasting, these cycles have continued. Apparently, forecasting doesn't work very well, or we would not have this problem. Or if the forecasts are accurate then semiconductor companies aren't acting on them. Either way, large semiconductor companies, (and I have worked for several) are the most internally focused organizations I have ever seen. Their needs come first, then investors, management and somewhere down the list might be the customers.

In the early days of the semiconductor industry the processes and technologies were internal and as one semiconductor executive once said, "real men have fabs." This was the attitude even as the cost of building and equipping fabs went from multimillions of dollars to multi-billions. Additionally, the top semiconductor companies owned the architectures and processes. So, their value propositions were that they had the fabs and the cores and topologies such as X86, 68000, PA-RISC, and Power-PC. In other words, semiconductor companies owned both the manufacturing and the device IP.

But then many vertical integrated companies got out of the semiconductor business, as mergers and acquisitions occurred. Moreover, the era of licensed architectures arrived with ARM, RISC-V and others becoming easily obtainable. The barriers to entry in making chips were slowly coming down. Today nobody cares about architecture—just use one of the defacto standards off-the-shelf.

I was present at a famous meeting at Motorola when a major customer arrived for a technology review. They mentioned that they had bought companies who were ARM licensees and wanted to collaborate on IC development using our joint IP. It was a gift from a customer who was looking to do more business with us.

But rather than expressing interest in their offer, our CTO (who had arrived late) stood up and went on a rant that "*We*, the semiconductor company" would decide on architectures and no architectures that we did not own would be made in our fabs. That was that, and he proceeded to leave the meeting in a huff.

The customer asked who that was and if he was the one who decided such things. After a long pause someone said yes it was the CTO and yes, it was his decision. From the looks on their faces, we could see that the customers were puzzled by this answer and what they heard from the CTO. Perhaps they were thinking how their CTO would not act like a spoiled child throwing a tantrum.

The customers then said that they were not here to ask our permission, they wanted to partner with us and do more business with us. So, if we weren't interested, they would take their business elsewhere. Of course, as a semiconductor company we were still fighting yesterday's war and were hanging onto value propositions that were rapidly going away. Fabs and architectures.

Fast forward to today when we have architectures and modules which one can license without any trouble at all. Additionally, the newer fabs are usually not ones built by semiconductor companies but rather by large contract fab companies and subsidized by governments. The latest downturn caused by a combination of Covid, demand upturn, the Russian invasion of Ukraine as well as other factors caused lead times to go to the max again, for a longer than usual period. This disruption to the supply chain has given customers another reason to avoid their traditional dependence on semiconductor companies and work directly with the fabs.

But they had plenty of reasons to do so before the pandemic. Often being a customer of a semiconductor company is an unpleasant experience. These companies, especially the large ones, can be arrogant and self-centered. Moreover, the larger semiconductor companies have agendas and margin goals, optimizing products for markets and business cases, not individual customers. In short, if you are a customer of a semiconductor company you are *a* customer, but not *the customer*.

They have other customers too and of course the investors—Wall Street, who are the real customers. These investor customers have become more important in the modern world than the product-purchasing customers. Among other problems, semiconductor companies can also be unpredictable. They can discontinue parts with little notice, push out lead times, give capacity to more-favored customers and do other unpleasant and unexpected things.

The investors of course want to hear about all the fantastic design-ins and wonderment of Mr. Big OEM's usages. This could result in a cascading failure mechanism for the semiconductor company. For example, sometimes they get bypassed by the large OEM. So, then they cannot write wonderful things about the usages, which drops revenue and stock prices, while the OEM finds they can get by simply fine without them. This means the semiconductor company becomes even less relevant to other large OEMs and so on. This makes things worse of course.

Currently, this discussion of make versus buy only applies to the "gorilla" parts. In other words, SOCs, highly integrated ICs, multicore processors, and perhaps RFICs—the more specialized and complex devices. In other words, the electronics customers can take matters into their own hands by hiring smart designers who might generally prefer to work for the big OEM vs. a semiconductor company, and fab the parts in whatever foundry suits them.

In that case, if you're the customer, you don't have to put up with the dysfunctional semiconductor company's erratic ability to do what you need or deliver products. Your IC can be exactly what you want it to be, it can give you a competitive advantage and you don't have to use a part optimized broadly for a large customer base.

Furthermore, you don't have to put up with the "I need a business case" from the semiconductor marketing teams. If your foundry can deliver, you can cut out the intermediary (the semiconductor company) who might send your fab capacity or parts to another, more-favored customer. And of course, the semiconductor company is keeping a big cut of the margin for themselves.

So, if you are a large electronics company and you just went through years of not being able to get products you need, why would you sign up for more abuse? This is why we see the announcements in the industry publications about so-and-so partnering with "insert foundry name here" to build their latest highly integrated processor and multifunction IC. It gives them the competitive advantages they need to win in the market, and they don't have to put up with suppliers who act like teenagers.

This trend is putting more pressure on the semiconductor companies to find some technologies which are not otherwise available via the foundry partners. Their other option is to hire better, smarter engineers than the OEMs can. However, this isn't necessarily that easy since it might be more prestigious and lucrative for the

engineers to work for the significant OEM than for the semiconductor company. It's hard-to-find good talent as evidenced by the ongoing announcements of talent shortages in the industry.

With this talent shortage in mind what are the large electronics companies not going to do themselves? Discrete semiconductors. In general, it's probably not worth it to design and contract the building of small-signal devices and discretes, commodity linear devices, high-function analog ICs, data converters and most specialty RF devices. Also, with integrated modules like Wi-Fi and LTE modules, it's easier to buy those than build them, in part because they need FCC and other certifications that are complex and costly to obtain.

The large electronics companies will be evaluating the design and make-vs-buy based on whether it gives them a competitive advantage, whether they have the needed skillsets to design and make the device and whether they can get the device in question on the open market from several suppliers. Regular power semiconductors and ICs, TVSs, rectifiers, MOSFETS, and regulators such as the LM78xx, LM1117, and LM317 will just be bought from suppliers because no competitive advantages can be obtained by designing and having a foundry build them.

On the other hand, highly specialized PMUs and PMICs that are differentiated, highly integrated and can give a competitive advantage, probably will be designed in-house. FPGAs are probably safe for applications that don't dictate high enough volumes to make a custom IC. As an aside, it's interesting how the large, formerly independent FPGA companies are now owned by major microprocessor semiconductor companies. That was a good way for the microprocessor manufacturers to hedge bets when companies that don't have the volumes for custom ICs need something they can customize without designing and fab'ing their own SOC processor system.

What about WBG devices? SiC an GaN? I simply don't know—we will see. There are foundries for WBG devices too so if the suppliers get fussy it's possible that an OEM could bypass them. You do see major OEMs partnering with WBG semiconductor companies. However, if they don't perform, the next step could be to toss that partner into the weeds, and get a foundry partner who can deliver what they want.

Additionally, the GPU companies are probably safe unless the major electronics companies integrate GPU cores into SOCs or other devices. Perhaps AI will start designing ICs or the AI processors will be integrated into the SOC. It's going to be interesting to see how this develops and I am glad that I am mostly watching from the bleachers.

It's natural to wonder what the semiconductor companies are doing about this loss of business to the foundry companies. You would think there would be a panic with management crying "what are we going to do?" Well, like Polaroid, Kodak, RCA and other industry giants who came before, they seem to be turning a blind eye to the changes. The attitude seems to be "everything is going to be fine, we have been here forever, and we will be here forever."

If the chip makers are concerned, it's not showing. Although I could be wrong and they may be holding internal meetings about future threats and opportunities, my impression is that they are too internally focused for that. Changing the culture of arrogant entitlement is difficult.

Only time will tell how this will shake out. But the foundry companies are not going away, so OEMs will continue to have the option of make versus buy for semiconductors. And when supply chain shortages are a determining factor, as they have been in the automotive industry, it will only push equipment manufacturers more in the direction of designing their own chips and having them built in fabs, removing the semiconductor middlemen.

Semiconductor companies created this customer behavior through their actions, so my thinking is "you broke it, you fix it—if it's not too late". But they probably don't even realize that they caused the customers to explore alternative options in the first place. After all, no single raindrop thinks it's responsible for the flood.

On the other hand, looking at the big picture, it's probably just the natural course of the industry. Years ago, electronics companies were vertically integrated to the extent that they made their own PCBs, chassis and enclosures. Now they simply design or specify them and have their PCBs made and populated elsewhere as are other mechanical parts. Perhaps customers designing their own chips is simply the next step in this process.

For Further Reading

On semiconductor companies' difficulties in forecasting:

1. "How the world went from a semiconductor shortage to a major glut" by Arjun Kharpal, CNBC.com, July 27, 2023.

On the availability of chip architectures:

2. A chip design that changes everything: 10 Breakthrough Technologies 2023" by Sophia Chen, MIT Technology Review, January 9, 2023.

On OEMs partnering with foundry companies to make their own chips:

3. "General Motors signs deal with GlobalFoundries for exclusive U.S. semiconductor production" by Michael Wayland, CNBC, February 9, 2023.

4. "GM–GlobalFoundries Partnership Seen as Setting Trend" by Alan Patterson, EETimes, March 31, 2023.

5. "Apple Wants More of its Own Chips, Revolutionizing the Supply Chain" by Pablo Valerio, EPS News, January 26, 2023.

6. "Stellantis builds a 'comprehensive ecosystem' to avoid key EV supply chain risks" by Peter Johnson, Electrek, July 18, 2023.

About The Author

Kevin Parmenter is an IEEE Senior Member and has over 20 years of experience in the electronics and semiconductor industry. Kevin is currently director of Field Applications Engineering North America for Taiwan Semiconductor. Previously he was vice president of applications engineering in the U.S.A. for Excelsys, an Advanced Energy company; director of Advanced Technical Marketing for Digital Power Products at Exar; and led global product applications engineering and new product definition for Freescale Semiconductors AMPD - Analog, Mixed Signal and Power Division.

Prior to that, Kevin worked for Fairchild Semiconductor in the Americas as senior director of field applications engineering and held various technical and management positions with increasing responsibility at ON Semiconductor and in the Motorola Semiconductor Products Sector. Kevin also led an applications engineering team for the start-up Primarion. Kevin serves on the board of directors of the PSMA (Power Sources Manufacturers Association) and was the general chair of APEC 2009 (the IEEE Applied Power Electronics Conference.) Kevin has also had design engineering experience in the medical electronics and military electronics fields. He holds a BSEE and BS in Business Administration, is a member of the IEEE, and holds an Amateur Extra class FCC license (call sign KG5Q) as well as an FCC Commercial Radiotelephone License.