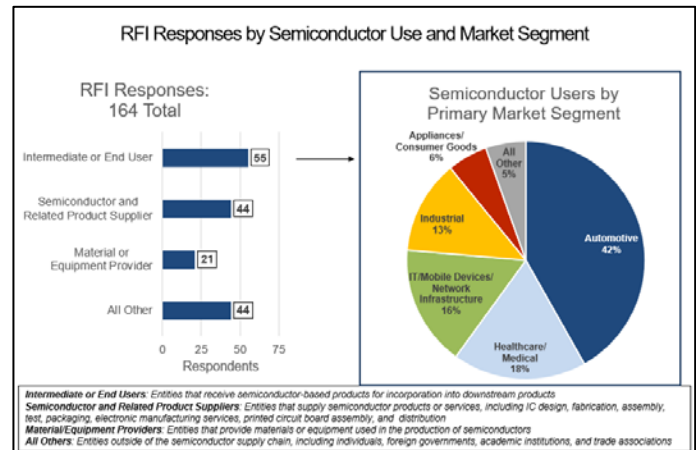


Summary Information on Responses to Request for Public Comments on Risks in the Semiconductor Supply Chain, Issued September 2021

Responses

- 164 total responses, 82 with structured information on production or consumption of semiconductors
- Responses from the U.S. and 12 other countries
- Respondents cover an estimated 80% of integrated circuit supplier market share and a higher percentage of foundry market share
- The automotive and medical industries were most strongly represented, having experienced major semiconductor-related impacts
- Over 450 pages of supplemental business confidential information on semiconductor supply chain challenges



Supply and Demand

- Overall chip production strongly increased from 2019 to 2021: the quantity of chips produced rose by an average of 32%
- Share of production for mobile devices and servers rose the most from 2019 to 2021, with the relative share of chips sold to automotive, medical, and industrial sectors falling (though still rising in unit and dollar terms)
- Excess demand was concentrated in the automotive sector; while overall book-to-bill ratios rose from a median of 1.0 in 2019 to 1.13 in 2021, book-to-bill ratios among producers whose primary end use was automotive rose from a median of 1.05 in 2019 to over 2
- Most end users who reported on their total chip purchases were able to purchase more chips in 2021 than in 2019, but purchases of their most difficult-to-acquire chips were more challenging
- Lead times rose significantly for producers, from a median of 117 days in 2019 to 176 days in 2021
- Much of the increase in lead times may be attributable to increased time needed to acquire manufacturing inputs, which rose from a median of 60 days in 2019 to 182 days in 2021.
- Inventories (days of supply) were down for virtually all respondents

Median Book-to-Bill Ratios of Chip Suppliers			
Primary End Use	2019	2020	2021
Automotive	1.05	1.17	2.02
Mobile Devices	1	1.14	1.17
All Other	1	1	1.1
Aerospace	0.96	1.02	1.05
IT/Computers/Network Infrastructure	1.16	.99	1.02
Total	1	1.01	1.13

Supply and Demand: Key Quotes

"More semiconductors were sold in the third quarter of 2021 than in any quarter in the history of the industry, and total semiconductor sales in September 2021 were the highest ever in a month, demonstrating the industry's efforts to ramp up production. Yet even these historic numbers have not kept up with the unexpected and historic levels of demand." - Supplier

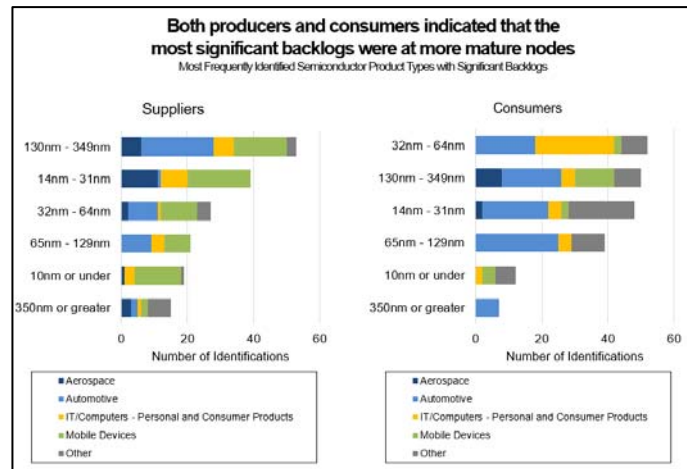
"Raw materials procurement lead times have increased significantly due to supplier capacity constraints." – Supplier

Automotive does not make up a significant portion of [our] business. ... The technology nodes that the automotive industry relies on – primarily 65nm, 40nm, and 28nm – are some of the most widely used nodes in the semiconductor industry. These nodes are extremely constrained, and customers for products in these nodes, in a wide variety of industries, are also experiencing severe shortages." – Supplier

"Pandemic-related shutdowns and stay-at-home orders spurred demand for goods and services that relied on semiconductors." – Intermediate/End User

Chip Types and Variation in Difficulty Acquiring

- More advanced chips generated by far the greatest revenue, with chips at or under 16nm representing well over half of the aggregate value of all chips produced in 2021
- Chips in the 130nm to 350nm range, however, were most frequently identified as having the most significant backlogs
- While in general respondents were able to purchase more chips in 2021 than in 2019, this was not the case for many of the difficult-to-acquire chips. The automotive sector was the primary sector in which respondents reported an inability to purchase more difficult-to-acquire chips in 2021 than in 2019
- Analog chips were most frequently cited by both suppliers and end users as having the longest order backlog and presenting the greatest challenge to acquire, respectively
- The semiconductor products with significant supply and demand mismatches are used by critical industries, including medical devices, broadband, and autos. They include:
 - Microcontrollers that are primarily made of legacy logic chips, including, for example, at 40, 90, 150, 180, and 250 nm nodes
 - Analog chips including, for example, at 40, 130, 160, 180, and 800 nm nodes; and
 - Optoelectronic chips including, for example, at 65, 110, and 180 nm nodes



Chip Types and Variation in Difficulty Acquiring: Key Quotes

“While leading-edge single-digit nanometer chips are important, the industry needs to re-balance and re-focus on the larger, pervasive market ... that is associated with the chip shortage. ... Governments, which historically have targeted their subsidy programs at the leading-edge, need to re-focus a significant portion of their programs to accelerate the creation of additional capacity in the pervasive sector.” –Supplier

“Anything from the 55 nm to the 180 nm technology nodes ... represents [nearly all] of our demand. The root cause in our opinion is the lack of manufacturing capacity along the semiconductor value chain and investment in the technology appropriate to [our industry]” – Intermediate/End User

“Among the shortages, analog products are the most critical ones. ... These include interface ICs, power management devices, and converters. Most of those parts are single source devices designed for specific applications and are going through a complex manufacturing process. While a few suppliers have invested in 300mm factories, most of those components are made in mature technologies (200mm fabs, 60/90nm lithography). Little investment is going toward those more mature technologies, so capacity growth is somewhat limited.” – Intermediate/End User

Perspectives on Disruptions

- Many chip suppliers reported working to increase communication with their customers for allocations of chips with scarce supply. They also indicated they often provide preference to long-time customers or customers with long-term future commitments, which may present challenges for newer and smaller customers
- Both consumers and suppliers indicated that lack of available wafer capacity was one of the most significant challenges for the industry, along with disruptions caused by temporary factors, such as COVID-related shutdowns, fires, and weather events
- Nearly all consumers indicated they had experienced de-commits from chip suppliers, often with immediate production ramifications

Perspectives on Disruptions: Key Quotes

"Building out additional semiconductor manufacturing capacity ... is a capital and time-intensive process. Agreeing to long-term purchase commitments ... would increase manufacturers' confidence in end-user demand for new capacity that the industry is working to bring online to address recent shortages." - Supplier

"Due to requirements by our suppliers, we have also entered a larger number of commitments and for longer time-period. Many suppliers have altered purchasing terms that impact duration and cost including provisions that make commitments non-cancellable and non-reschedulable." – Intermediate/End User

"Almost every supplier has given us decommit orders. Recently, most suppliers are reluctant to commit to volumes more than a few weeks out." – Intermediate/End User

Additional Views and Respondent Recommendations

- With chip suppliers operating at historically high capacity utilization, most respondents indicated that the most appropriate long-term response was increased investment and expansion of production capabilities, which can be supported by government incentives
- Increased investment is necessary across the supply chain, from material inputs and production materials to manufacturing equipment to assembly and packaging capabilities
- Increased availability is also needed for chips of all technology nodes; lack of investment and equipment availability for nodes above 65nm have led to difficulties producing items that rely on chips at larger nodes
- Consumers of chips suggested a need for firmer commitments from semiconductor suppliers, reducing the level of de-commits

Additional Views and Respondent Recommendations: Key Quotes

"Increased government R&D funding should be targeted toward areas that will bolster US fabrication capabilities and competitiveness, such as raw materials mining, packaging technologies, SRAM-replacement technologies, EUV lithography tooling, and methods to make US fabrication of prototypes and smaller-volume chips more economically viable." – Intermediate/End User

"Fabrication of semiconductors typically requires as many as 300 different inputs, including raw wafers, commodity chemicals, specialty chemicals, sputtering targets and bulk gases. Many of them also require advanced technology to produce." – Trade Association

"Building, upgrading or expanding domestic semiconductor fabs/foundries without having domestic suppliers of IC-substrates and OSAT assembly will lengthen the supply chain, not shorten it" – Trade Association

"Countless products critical to the safe and reliable operation of American infrastructure utilize older generation chip technology...Policies that focus exclusively on "next generation" chips will fail to fully address the identified problem" – Trade Association

"Single strand interventions that increase supply at one bottleneck are helpful, but not themselves likely to [solve the problem] if we still have insufficient production capacity in other parts of the process." – Intermediate/End User

Actions and Recommendations

- Industry-led solutions to increase production, effectively manage supply chains, and optimize product design
- Semiconductor suppliers may be able to lessen concerns about price gouging by engaging more directly with end users and exploring the use of sales contracts that prohibit re-sale at significant mark-up
- Continued U.S. Government data collaboration with industry to gather and share data to increase transparency
- Passing and implementation of the CHIPS Act to accelerate creation of additional semiconductor manufacturing capacity

Actions and Recommendations: Key Quotes

“The impact of supply bottlenecks is exacerbated when companies lack adequate access to information to manage inventory and plan future supply sources. The U.S. government should do what it can to minimize panics in the market by sharing such information as appropriate with companies that rely on semiconductors to make products that serve the U.S. market.” – Trade Association

“New, or low-tier brokers are entering the market to profit from semiconductor shortages (resulting in prohibitive manufacturing costs) and counterfeit semiconductors are also entering the market, causing delays, increased costs and necessitating enhanced due diligence. Prices for some components sourced on open market from brokers requires upfront payment with a 1500% price increase.” – Intermediate/End User

“Congress must ensure that the Commerce Department has the flexibility to provide incentives in the Section 9902 program for new and expanded facilities to produce [equipment] and semiconductor materials. This will ensure that expanded U.S. semiconductor production is not restrained by shortages of needed equipment and materials” – Trade Association