Where Are We Going?

- Where We’ve Been
- Looking Forward ~ 2021
- Speaking of Technology and the Economy …
- What About the Electronics & Components Supply Chain?
- Electronics & Components Market Drivers
- The Vision Thing


Electronic Components Industry Association
Where We’ve Been

~ Up to End 2020 ~
A Whipsaw Disaster That Required a Nimble Response

Whipsaw – To beset from two or more sides at once
The impact of government quarantine orders and directives on your company’s workforce and operations.
COVID-19 Supply Chain Impact – 2020

Index of "concern regarding these issues due to the Coronavirus / COVID-19 impact through 2020"

SCALE: Severe = 100; Moderate = 50; None = 0

- Raw Materials Disruption
- Electronics Systems Manufacturing Disruption
- Loss of End-Market Demand Due to Recession
- Electronics Components Manufacturing Disruption
- Shipping and Logistics Disruption
- Overall Average

Source – ECIA
COVID-19 Supply Chain Impact – 2020

Index of "Impact level of the Coronavirus / COVID-19 on market demand"

SCALE: Strong Increase = 100; No Change = 50; Strong Decrease = 0

Source – ECIA
Looking Forward
~ 2021 ~
Semiconductor Revenue Growth Cycle

- Quarter-over-Quarter took a hit in summer 2020
- Annual revenue cycle trends up starting September 2019
- Annual revenue growth profile continued steady through 2020
- Annual revenue growth breaks positive in August 2020
- Strong demand and technology drivers
- Accelerating growth in 2021?

Source – WSTS

Worldwide Semiconductor Revenue Growth

Source – WSTS
Semiconductor & Passive Market Correlation

Semiconductors vs. Passive Components in $'s

World Sales % Change Yr\Yr ($s)

Semiconductors a Good Proxy for Passive Component Growth Worldwide

But NOT in the Americas
Electronic Component Revenue Growth

World Revenue Growth

Americas Revenue Growth

Source: World Semiconductor Trade Statistics (WSTS), World Passive Trade Statistics (WPTS)
Semiconductor Growth Trends

Quarter-over-Quarter Growth

Source: WSTS
Different Trends for Different Markets - Alignment Diverging

- Every component category has now achieved positive qtr-over-qtr growth
- Sensors, Analog ICs, Discretes, and Logic surging
- Optical and Micros recovering
- Pricing collapse clips the wings of Memory ICs

Source - WSTS

Americas Semiconductor Market was Surging

- Americas growth showing the widest swings driven by memory
- Japan moves from stagnant to growth
- EMEA achieves growth after a brutal two-year stretch
Solid Start to Current Cycle
Most cycles last about four years

Source – WSTS

Low point in current cycle = -12.7 in Nov ’19


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North America Sentiment Survey Trends

- Strong start to 2021 across all categories
- Seasonal pause in December
- Important to remember context – Month compared to prior Month
- Above 100 means continued improvement – Like keeping foot on accelerator

North American Sales Performance Compared to Prior Month

Source: ECIA Electronic Component Sales Trends Survey
North America Sentiment Survey Trends

- What a difference a year makes!
- Broad-based confidence across the market
- Industrial, Medical & Automotive lead in optimism
- Even Mobile Phones & Avionics/Military/Space see over 50% growth expectation
North America Sentiment Survey Trends

- Positive growth expectations range between 72% and 81% of survey respondents.
- Semiconductors, Capacitors and Connectors see the strongest expectations in growth above 5%.
- Overall strong alignment across product categories in growth expectations.

Source: ECIA Electronic Component Sales Trends Survey
GDP Forecast Scenarios – The Swoosh Scenario?
Economic Risk Factors

Economic Confrontations Between Major Powers

- World trade in manufactured goods has more than doubled between 2000 and 2017—from $4.8 trillion to $12.2 trillion. The U.S. share of world trade in manufactured goods has grown from 7.6% in 2002 to 8.7% in 2017. (Source: World Trade Organization)

- Globally Weak Investment Due to Low Expected Returns, Uncertainty About Economic Policy

Small Business Health

- The majority of manufacturing firms in the United States are quite small. In 2017, there were 248,039 firms in the manufacturing sector, with all but 3,914 firms considered to be small (i.e., having fewer than 500 employees). In fact, three-quarters of these firms have fewer than 20 employees. (Source: U.S. Census Bureau, Statistics of U.S. Businesses)

- Unemployment and State Lockdown Orders

Energy Shocks

- Manufacturers consume more than 30% of the nation’s energy consumption. Industrial users consumed 32.3 quadrillion Btu of energy in 2018, or 32.3% of the total. (Source: U.S. Energy Information Administration, Annual Energy Outlook 2019)

- A new global map being shaped by dramatic shifts in energy and geopolitics—a map defined by changing policies, technology, alliances, geopolitics, and possibly collisions in global commerce and politics.

Societal and Political Turmoil
What is the Anticipated Impact of a New Administration?

The Impact of Presidential Elections on Economic Growth

US Real Gross Domestic Product Growth One Year After the Election

- 5.0
- 4.2
- 2.7
- 2.6
- 3.1
- 2.6
- 2.7

3/12 Rate-of-Change
Source: BEA

Speaking of Technology and the Economy...
World Electronics Value Chain - 2019

- **Market Service Providers**: $55,800B
  - Transportation, Health, Installation, Maintenance, Repair, etc.
- **Industrial Equip.**: $1,650B
  - Consumer / Stand-Alone Electronics
    - PC, Telecoms, Video, Audio
    - $1,366B
  - Embedded Electronics
    - Auto, Industrial, Medical, Aero / Defense
    - $1,063B
  - Total Electronics Equipment: $2,429B
- **Electronic Components Distribution**: $81B
  - Semiconductors: $411B
  - Other Elec. Components: $131B
  - Materials & Tools: $106B
- **Aero / Defense**: $1,835B
- **Automotive Equip.**: $2,000B

A Brief Message from Our Sponsors …

PLEASE SUPPORT THE DTAM SURVEY!

Final Day – Thursday, March 25th

The Increasing Economic Influence of Technology

Big Tech as a Share of the S&P 500 Index
5 Companies' Aggregate: 23.1%

S&P 500's 10 biggest market caps

<table>
<thead>
<tr>
<th>Company</th>
<th>Market Cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apple</td>
<td>$1.395B</td>
</tr>
<tr>
<td>Facebook</td>
<td>$622B</td>
</tr>
<tr>
<td>Berkshire Hathaway</td>
<td>$555B</td>
</tr>
<tr>
<td>Microsoft</td>
<td>$1.259B</td>
</tr>
<tr>
<td>Visa</td>
<td>$442B</td>
</tr>
<tr>
<td>Alphabet</td>
<td>$1.01B</td>
</tr>
<tr>
<td>JP Morgan Chase</td>
<td>$418B</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td>$390B</td>
</tr>
<tr>
<td>Amazon</td>
<td>$923B</td>
</tr>
<tr>
<td>Mastercard</td>
<td>$332B</td>
</tr>
</tbody>
</table>

Source: S&P Capital IQ, as of Jan. 27, 2020


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Top 20 Technology Companies See Market Cap 7x of 1998

Market Capitalization

Most Recent IPOs
2. Alibaba (2014)
3. Facebook (2012)
10. Amazon (1997)

Source – ECIA
COVID-19’s Dramatic Impact on the Auto Chip Market

Automotive Chip Crunch Exposes Supply Bottleneck

- Major auto production lines shut – annual losses estimated in billions of dollars
  - Miscommunication between auto manufacturers and suppliers
  - 200 mm fabs at 100% capacity with no room for automotive upside
  - Appeals to Taiwan from government economy ministers
  - TSMC agrees to “Hot Hot Runs” – expensive and potential equipment damage.
  - Automotive market mismatched with foundries – Low Volume, Short/Bursty runs

- 200 mm capacity now impacting other markets in smartphones & computers
- ECIA CEO releases statement highlighting missed benefits of using distribution
  - “To minimize future supply chain disruptions, it is imperative for industries like automotive to efficiently and effectively employ the resources and options available to them, and a huge, under-utilized resource available today is the **authorized channel of electronics distribution**.” – David Loftus, CEO

THE WALL STREET JOURNAL

Big Automotive Chip Shortage Is No Surprise

The focus on lean should have been balanced with a pragmatic view on the extreme cost of idled automotive production lines.

The collaboration between authorized distributors and automotive manufacturers presents a wealth of opportunity to minimize future disruptions.

David Loftus
President and CEO
Electronic Components Industry Association

North America Lead Time Trends – Bullwhip Effect

Average Lead Time In Weeks

INTERCONNECT & ELECTROMECHANICAL | PASSIVES | SEMICONDUCTORS

CUSTOMER | RETAILER | DISTRIBUTOR | MANUFACTURER

Average Lead Times In Weeks

Semiconductor Devices

CLOCK & TIMING ICS
CONTROLLER / PROCESSOR
DISCRETE
LINEAR
LOGIC
MEMORY
OPTOELECTRONICS
RF & MICROWAVE

Source: ECIA
The Challenge of Balancing CAPEX

Surge vs Steady State

- Strong addition of fab capacity in 2020 still outstripped by surge in demanding starting in H2 2020
- Added CAPEX investments by major fabs announced
- But, building new fabs typically takes 18 to 36 months
- Will steady state demand settle back and eventually leave industry with excess capacity?
- This is the continual semiconductor industry challenge and a driver of the cycle

63 companies own a 200mm fab (down from 76 in 2007)
28 companies own a 300mm fab
Global Trade Critical to Healthy Tech Economy
Electronics – Global but Concentrated

**SEMICONDUCTOR SALES BY MARKET**
- Wireless (Inc Smartphone) 30%
- Compute/Data Processing 36%
- Automotive 8%
- Consumer 9%
- Industrial 11%
- Telecom 6%

**SEMICONDUCTOR SHIPMENTS BY REGION**
- Asia-Pacific 73%
- Americas 10%
- EMEA 10%
- Japan 7%

Source – OMDIA

World’s 60 Most Innovative Economies

Metrics
• R&D Intensity
• Manufacturing Value-added
• Productivity
• High-tech Density
• Tertiary Efficiency
• Researcher Concentration
• Patent Activity


The Push to Rebuild US Semiconductor Manufacturing

- Congressional legislation
  - Creating Helpful Incentives to Produce Semiconductors (CHIPS) Bill
  - At least $22.75 B in funding/matching; Tax incentives; NIST/STEM/DOD initiatives and more
  - Promotion and lobbying by SIA
  - Bipartisan and Bicameral but died in last congress
  - Effort to reintroduce this congress

- Open letter from then Intel CEO, Bob Swan, to President-elect Biden
  - Urges U.S. government investment in the domestic semiconductor industry and support of immigration programs to find needed talent for the tech industry

- Recent advocacy by senators to White House in response to automotive crisis
  - Urged the White House "to support efforts to secure the necessary funding to swiftly implement the semiconductor-related provisions in the most recent National Defense Authorization Act…"

- New Executive Order – 100 Day Critical Supply Chain Assessment
Semiconductors as a Weapon

TSMC Sales Profile:
US = 60% of sales
China = 20% of sales

Trade headwinds creating headaches
“Our work relies on the free flow of knowledge and the free flow of trade which has no doubt been suppressed.”
- Mark Liu, TSMC Chairman

Taiwan government & industry groups take formal steps to localize semiconductor equipment production

“I could buy the same tennis racket as Serena Williams, but I’m not going to play as well as her.”
- Philip Wong, vice president of corporate research

“Connect. Influence. Optimize.”
Electronic Components Industry Association
Will “Bifurcation” Avoid Balkanization?

- Asymmetric Competition: A Strategy for China & Technology
  - Proposal produced by group formed by Eric Schmidt and Jared Cohen
  - Schmidt refers to proposal as “Bifurcation”
  - “Advances policies that position the U.S. to out-compete China without inviting escalatory cycles of confrontation, retaliation, or unintended conflict”

- Functional Capabilities a core part of proposal
  - “Supply Chains. Building more resilient supply chains is critical to diminishing our vulnerability to Chinese control, but will require significant investment in domestic infrastructure, ally-centric production, and advances in automation.”

- Next Generation Chips – Defined as “Critical Technology” in “Technological Battleground”

What About the Electronics & Components Supply Chain?
Lessons Learned – Proactive Risk Management

“Every 3.7 years on average, businesses can expect a supply chain disruption that lasts at least a month, and the most serious of these can have severe financial consequences”

2020 McKinsey Analysis

“Amnesia and misaligned incentives may be among our worst enemies when it comes to building supply chain resilience for the long haul. Managers would do well to assess their top risks and understand the corresponding risk profiles for each supplier.”

Lynn Torrel, Chief Supply Chain and Procurement Officer, Flex
# Lehigh University Supply Chain Risk Index – Q1 2021

- **Four Biggest Risks – Q1 2021**
  1. Transportation Disruption + 7.74
  2. Customer + 3.56
  3. Economic - 5.60
  4. Supplier - 2.50

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<table>
<thead>
<tr>
<th>Risk Type</th>
<th>Current Risk Index</th>
<th>Last Quarter Risk Index</th>
<th>Trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transportation Disruption Risk</td>
<td>77.34</td>
<td>69.60</td>
<td>Up</td>
</tr>
<tr>
<td>Customer Risk</td>
<td>74.22</td>
<td>70.66</td>
<td>Up</td>
</tr>
<tr>
<td>Economic Risk</td>
<td>72.66</td>
<td>78.26</td>
<td>Down</td>
</tr>
<tr>
<td>Supplier Risk</td>
<td>71.88</td>
<td>74.38</td>
<td>Down</td>
</tr>
<tr>
<td>Cybersecurity and Data Risk</td>
<td>71.88</td>
<td>72.13</td>
<td>Down</td>
</tr>
<tr>
<td>Government Intervention Risk</td>
<td>71.88</td>
<td>70.43</td>
<td>Up</td>
</tr>
<tr>
<td>Operational Risk</td>
<td>61.72</td>
<td>60.00</td>
<td>Down</td>
</tr>
<tr>
<td>Technological or Competitive Risk</td>
<td>55.47</td>
<td>58.26</td>
<td>Down</td>
</tr>
<tr>
<td>Quality Risk</td>
<td>55.47</td>
<td>56.80</td>
<td>Down</td>
</tr>
<tr>
<td>Environmental Risk</td>
<td>53.91</td>
<td>59.13</td>
<td>Down</td>
</tr>
<tr>
<td><strong>Average Risk Index</strong></td>
<td><strong>66.64</strong></td>
<td><strong>66.97</strong></td>
<td></td>
</tr>
</tbody>
</table>

*Source: Lehigh Univ, CSCMP*
Electronics & Components

Market Drivers
Market Outlook – Long Term Future Still Bright!

The Developing Technology Triumvirate

IoT

Perfect Storm

2020 / 2022

Cloud

Waves of Amplified Growth

5G
The Technology Triumvirate

**5G**

- Global IP traffic growing > 25% per year -> IP traffic between 2018 & 2024 will be four times greater than all IP traffic before
- Spec’d to deliver 1 million connections per square KM vs. 60,680 for 4G
- By 2022, 5G will comprise 3% of total mobile connections = 422M 5G devices & M2M connections -> by 2024 +23% of handsets

**IoT**

- 20B connected IoT devices in 2018 grow to 68B in 2025, 19% CAGR (source: Goldman Sachs)
- $2.7T - $6.2T economic impact in 2025 across all markets (source: McKinsey)
- 2020 IoT Chips = +$40B (source: SIA)
- Drives new productivity across $36T in operating costs in manufacturing, health care, utilities, logistics & mining

**The Cloud**

- Exponential growth in data generation, processing and storage
- Enables AI and the host of XaaS

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### Table 1. Worldwide Public Cloud Service Revenue Forecast (Millions of US Dollars)

<table>
<thead>
<tr>
<th>Service Type</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
<th>2022</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cloud Business Process Services (BPaaS)</td>
<td>45,212</td>
<td>43,438</td>
<td>46,287</td>
<td>49,509</td>
</tr>
<tr>
<td>Cloud Application Infrastructure Services (PaaS)</td>
<td>37,512</td>
<td>43,498</td>
<td>57,337</td>
<td>72,022</td>
</tr>
<tr>
<td>Cloud Application Services (SaaS)</td>
<td>102,064</td>
<td>104,672</td>
<td>120,990</td>
<td>140,629</td>
</tr>
<tr>
<td>Cloud Management and Security Services</td>
<td>12,836</td>
<td>14,663</td>
<td>16,089</td>
<td>18,387</td>
</tr>
<tr>
<td>Cloud System Infrastructure Services (IaaS)</td>
<td>44,457</td>
<td>50,393</td>
<td>64,294</td>
<td>80,980</td>
</tr>
<tr>
<td>Desktop as a Service (DaaS)</td>
<td>616</td>
<td>1,203</td>
<td>1,951</td>
<td>2,535</td>
</tr>
<tr>
<td><strong>Total Market</strong></td>
<td><strong>242,697</strong></td>
<td><strong>257,867</strong></td>
<td><strong>306,948</strong></td>
<td><strong>364,062</strong></td>
</tr>
</tbody>
</table>

*Source: Gartner*
AI – Principles, Predictions, Power

- AI helps improve: Predictions, Automation, Optimization

- Prepared to Accelerate
  - Harnessing vast amounts of data
  - Huge advances in software
  - Leveraging increased power of compute

- Adding “Deep Learning”
  - Go beyond data analysis; Think like a human - unstructured data, video, images

- Ethical Issues – Tech for good and Tech for bad
  - 3 IBM AI Principles
    - AI augments the human – not replace; Designed to enhance and extend
    - Data and insights generated belong to their creator
    - Must be transparent and explainable - attempts to eliminate bias

- Prediction – AI will contribute $16 T to economy by 2030

OMDIA AI Webinar Survey Results

How confident are you that AI will deliver positive results in the next 12–24 months?

- Very confident: 40%
- Confident: 33%
- Somewhat confident: 21%
- Not confident at all: 6%


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Market Outlook

- Technology and market drivers build momentum
- Economic stability needs to provide solid foundation
- Adoption of new technologies in systems drives expanding design opportunities
- Opportunities for new component technologies to make a mark
- But don’t overlook need for legacy manufacturing capacity

**Positives**
- Medical Equipment
- Data Centers
- Telecom Infrastructure
  - 5G
- Solid state drives
- “Touchless” solutions
- Memory
- Sensors

**Challenges**
- Automotive Electronic Component Supply
  - Expanding to others?
- Aerospace Electronics
- Global Trade
- Inventory / Supply Chain Management

Growth Drivers for Semis & IP&E Components

• New technologies enable/drive new system and network architectures
• Creation of new classes and categories of devices
• Motivator to upgrade and enhance current installed base of electronics
  o Commercial AND consumer / Competition
• Pressure on next level performance from devices through networks
  o GaN & SiC devices, process geometry shrinks, sensors, processing architectures, energy harvesting…

Technology / Market Disruption Will Create an Explosion in New Design Win Opportunities
Long-term Semiconductor Growth Trends

- Average annual growth since 2005 = 5.5%
- $750B by 2030?
- $1 T by 2036?
- HOW?
The Vision Thing
dream no small dreams for they stir not the hearts of men.”
– Johann Wolfgang von Goethe

“To look to the future, we must first look back upon the past. That is where the seeds of the future were planted. I never think of the future. It comes soon enough.”
– Albert Einstein

“Any sufficiently advanced technology is indistinguishable from magic”
– Arthur C. Clarke

“Shouldn’t we be content to be cosmic sloths enjoying the universe from the comfort of earth? The answer is: No.”
– Stephen Hawking
Vision: 2025 - 2026

Wearable tech is replaced by subdermal tech chips that are inserted beneath the skin and link users to their home and robotic devices, giving them control using verbal instructions.

People with medical issues are using Neuralink chips to make them better. The chip is able to restore eyesight and help people who are paralyzed to walk again.

Humans begin to interact with virtual reality artificial life living beings in a digital world that learn how to act, move, and interact with humans on their own, creating their own behaviors and way of life.
Vision: 2025 - 2026

Quantum computers are used in high-end chemical engineering. They are able to quickly design new medicines, biodegradable plastics, and building materials.

The interplanetary internet system goes online creating a computer network in space. The network is made up of landing robots, planet satellites, and earth ground stations.

5G networks carrying vast amounts of data take control of transportation flow systems and self-driving networks to improve urban flow.

Thank you!

Dale Ford – Chief Analyst
dford@ecianow.org