U.S. Department of Commerce
Bureau of Industry and Security
Office of Technology Evaluation

U.S. Bare Printed Circuit Board Industry Survey Results

IPC APEX Expo – Government Relations
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Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
BIS Industry Surveys & Assessments

Background

- Under Section 705 of the Defense Production Act of 1950 and Executive Order 13603, ability to survey and assess:
  - Economic health and competitiveness
  - Defense capabilities and readiness

- Mandatory data collection authority under Section 705 of the DPA with data exempt from Freedom of Information Act (FOIA) requests

- Enable industry and government agencies to:
  - Share data and collaborate in order to ensure a healthy and competitive industrial base
  - Monitor trends and benchmark industry performance
  - Raise awareness of diminishing manufacturing and technological capabilities
Bare Printed Circuit Board Assessment Sponsor

- Bureau of Industry and Security, in coordination with the U.S. Department of the Navy, Naval Surface Warfare Center, Crane Division (NSWC Crane) conducted an assessment of the U.S. Bare Printed Circuit Board (PCB) industrial base.

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
185 companies operate 202 bare printed circuit board manufacturing facilities in the U.S. - 2015

Number of Companies/Facilities by Bare PCB Sales

- Small: < $10M in sales
- Medium: $10M-$40M in sales
- Large: > $40M in sales

- 142 companies, 146 facilities
- 38 companies, 46 facilities
- 5 companies, 10 facilities

5 large companies operate 18 facilities in the U.S.

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare PCB Facility Capabilities

Manufacturing Services – All U.S. Bare PCB Facilities - 2015

PCB Design

Bare PCB Manufacturing

PCB Assembly

<table>
<thead>
<tr>
<th># of Facilities</th>
<th>Small &lt;$10M</th>
<th>Medium $10M-$40M</th>
<th>Large &gt;$40M</th>
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</thead>
<tbody>
<tr>
<td>All Facilities</td>
<td>61</td>
<td>47</td>
<td>145</td>
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<tr>
<td>Defense End Use</td>
<td>61</td>
<td>47</td>
<td>145</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified

Respondents: 202
Bare PCB Sales 2015 – By Company Size

Bare PCB Sales by Company Size – Total $2.03 Billion in 2015

- **Small <$10M**
  - 142 Small
  - $875 Million

- **Medium $10M-$40M**
  - 38 Medium
  - $722 Million

- **Large >$40M**
  - 5 Large
  - $432 Million

**Companies:**
- 10 Publicly Traded
- 175 Privately Held

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Bare PCB Sales 2012-2015
- Government vs. Non-Government Sales

Bare PCB Sales by U.S. Facilities 2012-2015

- **Government Sales**
- **Non-Government Sales** (Commercial)

Year | Government Sales | Non-Government Sales
--- | --- | ---
2012 | $392 | $1,578
2013 | $414 | $1,616
2014 | $426 | $1,582
2015 | $461 | $1,538

Source: U.S. Department of Commerce, Bureau of Industry and Security

U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified

202 respondents
Percent of Bare PCB Sales with Defense End Use – 2015

- 145 facilities (72%) reported defense end-use
- 58 facilities consider themselves dependent on the USG programs for their continued viability

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Defense End Use Market Segments

U.S. Bare PCB Facilities – Defense Segments Participation

- Electronics: 106 facilities
- Aerospace: 99 facilities
- Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR): 92 facilities
- Missiles: 72 facilities
- Marine (surface and underwater): 64 facilities
- Space: 62 facilities
- Ground Vehicles: 53 facilities
- Other: 26 facilities

Source: U.S. Department of Commerce, Bureau of Industry and Security
145 respondents
Competitive Factors – Reliance on USG Business

- A commercially healthy and viable PCB industrial base is essential in order to support DoD needs and requirements.
- DoD domestic sourcing can help support a healthy, robust and technically advanced domestic supply base that can compete commercially.

To what extent is this facility's continued ability to manufacture bare circuit boards for USG Customers dependent on the viability of your commercial circuit board business?

- Significantly: 74, 37%
- Moderately: 38, 19%
- Somewhat: 31, 15%
- Not at all: 39, 19%
- Not Applicable: 20, 10%

66% Dependent

To what extent is this facility's continued ability to manufacture bare circuit boards for Commercial Customers dependent on the viability of your USG business?

- Significantly: 70, 35%
- Moderately: 33, 16%
- Somewhat: 37, 18%
- Not at all: 24, 12%
- Not Applicable: 38, 19%

49% Dependent

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified

Q12b,A

202 respondents
## Current and Future Issues of Concern to Industry

<table>
<thead>
<tr>
<th>Issue</th>
<th>Current Impact</th>
<th>Future Impact</th>
<th>Both</th>
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<tbody>
<tr>
<td>Aging equipment, facilities, or infrastructure</td>
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<td>57</td>
<td>72</td>
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<td>Healthcare costs</td>
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<td>11</td>
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<td>Competition - foreign</td>
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<td>16</td>
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<td>Labor availability/costs</td>
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<td>Aging workforce</td>
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<tr>
<td>Competition - domestic</td>
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<tr>
<td>Worker/skills retention</td>
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<td>21</td>
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<td>Reduction in commercial demand</td>
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<td>22</td>
<td>89</td>
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<td>Taxes</td>
<td>22</td>
<td>5</td>
<td>111</td>
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<tr>
<td>Environmental regulations/remediation - domestic</td>
<td>36</td>
<td>22</td>
<td>79</td>
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<td>Government regulatory burden</td>
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<td>10</td>
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<td>Reduction in USG demand</td>
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<tr>
<td>Health and safety regulations</td>
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<td>11</td>
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<tr>
<td>Qualifications/certifications</td>
<td>16</td>
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<td>Cyber security</td>
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<td>Material input availability</td>
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<td>Obsolescence</td>
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<td>Government purchasing volatility</td>
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<td>38</td>
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<tr>
<td>Environmental regulations/remediation - foreign</td>
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<td>35</td>
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<tr>
<td>Proximity to suppliers</td>
<td>7</td>
<td>22</td>
<td>33</td>
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</tbody>
</table>

| Source: U.S. Department of Commerce, Bureau of Industry and Security |
| U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified |

202 respondents
Need for R&D and Capital Investment (CAPEX)

- Technology and processes advance rapidly driving need for new equipment
- PCB manufacturing is a process that is both capital and technology-intensive
- Manufacturers need to add to or update techniques and equipment regularly to remain globally competitive
- Cost of equipment and innovation has resulted in a gap between large and small manufacturers

Reported Average Net Profit Margin (2012-2015):
- Large - 6.7%
- Medium - 5.3%
- Small - 1.6%

Reported Average Net Sales per Employee (2012-2015):
- Large – $ 3.53M
- Medium - $2.12M
- Small - $153K

Bare PCB CAPEX as a percentage of 2015 sales:
- Large – 2.1%
- Medium – 4.1%
- Small – 6.2%

Only 38 out of 185 companies reported conducting R&D:
- Large - 5 (80%)
- Medium - 15 (39%)
- Small - 20 (13%)

Source: U.S. Department of Commerce, Bureau of Industry and Security
R&D – Bare PCB/Defense-Related Expenditures

U.S. Bare PCB Facilities R&D Expenditures 2012-2015

- Total R&D Expenditures
- Bare Circuit Board R&D Expenditures
- Defense-Related Bare Circuit Board R&D Expenditures

Source: U.S. Department of Commerce, Bureau of Industry and Security

39 respondents
Need for R&D and Capital Investment (CAPEX)

There is a notable difference in investment in continuous technology innovation between smaller and larger U.S. PCB manufacturers.

Why this is a problem for small-scale PCB enterprises:

- Lack of sufficient investment
- Ability to innovate is affected
- Further limits the need for further innovation
- Can become bound to a limited market

Less Innovation

Less increase in productivity

Combined with intense price competition from foreign competitors, U.S. manufacturers cannot raise prices to offset rising production costs.

Less increase in productivity also puts pressure on manufacturers facing increasing labor costs and talent acquisition challenges.

Source: U.S. Department of Commerce, Bureau of Industry and Security
## CAPEX: Top Priorities for U.S. PCB Manufacturers

### Top 5 bare PCB-related CAPEX priorities (2016-2020) - Ranked

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Priority 1</th>
<th>Priority 2</th>
<th>Priority 3</th>
<th>Priority 4</th>
<th>Priority 5</th>
<th># of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment for new technologies</td>
<td>110</td>
<td>80</td>
<td>60</td>
<td>40</td>
<td>20</td>
<td>202 respondents</td>
</tr>
<tr>
<td>Equipment for existing technologies</td>
<td>80</td>
<td>60</td>
<td>40</td>
<td>20</td>
<td>0</td>
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<td>IT/computers/software</td>
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<td>30</td>
<td>20</td>
<td>10</td>
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<tr>
<td>Other</td>
<td>10</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

### Equipment Priorities for New Technologies

- Flex and Rigid Flex capability
- Lead-free hot air solder leveling (HASL)
- Expand capacity in high density interconnect (HDI) technology
- Ink-jet nomenclature application
- Printed electronics
- Laser direct imaging equipment
- Advanced processing technologies and advanced materials
- Light emitting diode (LED)
- Application of masks and inks
- Sequential lamination equipment
- Solder mask spray unit + etcher
- High temperature lamination for fusion bonding
- Advanced develop-etch-strip / design (DES) equipment
- Drilling equipment for finer features
- Plasma etch
- Laser drill
- Optical routing
- Reverse pulse plate plating technologies
- Automated optical inspection equipment
- Electroless nickel immersion gold (ENIG) plating process
- Advanced test equipment
- Pulse rectification: electro-copper

### Equipment Priorities for Existing Technologies

- High density interconnect (HDI) capability
- Permanganate Desmear
- Direct imaging
- Via fill and planarization equipment
- Laser direct imaging
- CMM
- Photo plotting system
- Lamination presses
- Develop-etch-strip / design (DES)
- Vacuum lamination presses
- Plasma etching
- Automated hole alignment, camera assisted drill
- Ink jet sprayer for solder mask
- Laser drills
- Legend Ink Jet Printing
- Deburr equipment
- Etching equipment
- Routing equipment
- Copper electroplating equipment
- Coordinate measurement machine (CMM)
- Advanced plating rectifiers for copper-filled vias
- Additional measurement equipment
- Electroless nickel immersion gold (ENIG) plating process
- Electrical test equipment

Source: U.S. Department of Commerce, Bureau of Industry and Security
Manufacturing Limitations Due To Equipment

U.S. PCB manufacturing facilities – over half reported equipment-related production limitations

Are there bare circuit board products that this facility is unable to manufacture due to the limitations of installed equipment?

- Large >$40M
- Medium $10M-$40M
- Small <$10M

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Rejected Customer Business Opportunities

Factors for Rejecting Business Opportunities

- **Complexity of job**: 127
- **Customer credit rating**: 72
- **Insufficient dollar value of job**: 69
- **Insufficient dollar value of recurring business opportunity**: 36
- **Insufficient order frequency**: 15
- **Other criteria**: 12
- **Additional work not needed**: 12
- **Circuit board panel production run too small**: 11

**EXPLANATIONS:**

**Complexity of job:**
- “Do not posses manufacturing capabilities to produce latest technology complex circuit boards”
- “Some board requirements may be beyond our capabilities.”
- “Too high layer count, too tight lines/spaces, exotic materials, etc.”
- “PCB layer count beyond our capabilities.”
- “Need more equipment.”

**Other comments:**
- “Lacking credentials (e.g., MIL-PRF-31032)”
- “We are not a military approved facility.”
- “Our minimum lot charge is higher than commercial competition due to MIL documentation.”

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
What advanced bare circuit board-related technologies should DOD support to better enable manufacturers to meet future national security requirements?

- Stretchable/wearable electronics: 24 responses
- Advanced embedded active/passive device methods: 24 responses
- Enhanced solid copper via fill methods: 22 responses
- Development of very thin unsupported dielectrics: 15 responses
- Printed electronics (additive, 3-D, etc.): 12 responses
- Direct IC die-on-board ultra high density interconnects: 8 responses
- Sub-10 micrometer photoresists, etchants: 7 responses
- Ultra smooth copper foil: 6 responses

Maximum 3 anticipated top R&D priorities per facility - total of 606 responses

Source: U.S. Department of Commerce, Bureau of Industry and Security
Need for R&D and Capital Investment (CAPEX)

- “Innovation is important to meeting both legacy and future DoD needs.”

- R&D for PCBs has shifted offshore (partly due to foreign government R&D support and growth in Asian PCB manufacturing)

- U.S. PCB manufacturers, facing lower margins and lower sales volumes, are becoming limited in their investments in R&D, technology, and innovation.

  Comments:
  - “The Asian market has driven the commercial market share out of the country. The small companies cannot afford the equipment needed for technology advancement.”
  - “Large portion of the US bare circuit board industry, (137 out of 202, 68%) are sub $10 million in revenue that have not been able to recapitalize and have aging ownership.”
  - “Lack of capital investments by these facilities makes them non-competitive technologically – and therefore do not have the capability to meet today’s demands.”
  - “In the U.S., only the remaining large public and private PCB companies will be able to afford the necessary capital costs for acquiring state-of-the-art equipment.”

- It is imperative for the U.S. PCB industry to make the investments in advanced manufacturing required in order to maintain competency and competitiveness with the global leaders in China, Taiwan, and Japan.

- **RECOMMENDATIONS:** U.S. PCB Industry partnership and collaboration efforts (consortium) to conduct R&D?
  - Possible partners - NIST, DARPA, iNEMI, Universities, others?
  - Increase investments in basic technology, product R&D, and process R&D.
  - Creation of tax incentives, rebates or credits for DoD suppliers of PCBs in order to renew interest and investment by U.S. PCB manufacturers.
Factors Affecting Facility Interest in USG Business

- DoD is often perceived as a difficult customer for small businesses or commercial businesses.
- Challenges:
  - Unique requirements - highly specialized boards, special functions and requirements.
  - Diminishing purchasing position in the overall PCB market.
  - Demand for higher technical performance at an affordable cost.
  - Administrative burden, low-volume, infrequent orders.
  - Legacy products production – costs and challenges.

Indicate whether the following factors affect this facility's interest in U.S. Government business.

<table>
<thead>
<tr>
<th>Factor</th>
<th>May Cause Facility to Stop Producing for USG</th>
<th>Reduce Interest in USG Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paperwork/Requirements</td>
<td>24</td>
<td>88</td>
</tr>
<tr>
<td>Insufficient Profit Margin</td>
<td>47</td>
<td>80</td>
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<tr>
<td>Slow Payment</td>
<td>23</td>
<td>60</td>
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<tr>
<td>Infrequent Orders</td>
<td>19</td>
<td>58</td>
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<tr>
<td>One-off orders</td>
<td>9</td>
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<tr>
<td>Small Production Lots</td>
<td>8</td>
<td></td>
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<tr>
<td>Intellectual Property Protection</td>
<td>6</td>
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</tr>
</tbody>
</table>

Other Factors:
- ITAR & FEDBID.com
- Employment Rates/Future Additions

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Working with DoD – MIL Certification

• Only 31% of U.S. PCB manufacturing facilities hold an official MIL certification.
  - MIL-PRF 31032: 42 total facilities (only 14 of 146 small)
  - MIL-PRF 50884: 24 total facilities (only 11 of 146 small)
  - MIL-PRF 55110: 55 total facilities (only 28 of 146 small)

• Comments:
  - “We recently dropped MIL certification due to increasing requirements burden. “
  - “Cost of compliance to MIL specs, etc. could result in a few suppliers getting all the business. Our business serves medical market, industrial market and military markets. Separate and unique certifications and systems compliance for each segment results in a lot of additional (LOW VALUE) effort and support.”
  - “We have avoided government space applications due to stringent testing and paperwork requirements. Needs a full time program manager with experience.
  - “Testing & documentation relative to other customers is extreme.”

• RECOMMENDATION:
  - Increase/create funding program to help small U.S. PCB manufacturers achieve formal certifications. (ex: MIL-PRF).
### Facility Manufacturing Capabilities - Standards

#### Standards Employed by U.S. Bare PCB Facilities

<table>
<thead>
<tr>
<th>Standard</th>
<th>Formal Certification</th>
<th>Informal Use</th>
<th>Not Used</th>
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<td>NADCAP</td>
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<td>MIL-PRF 55110</td>
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<td>AS 9100</td>
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</tbody>
</table>

*Source: U.S. Department of Commerce, Bureau of Industry and Security*

*U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified*
Supply Chain

• U.S. PCB manufacturers are confronted with a diminished supply chain as well as diminishing number of downstream customers.
  - PCB are intermediate products, not end products. As electronic systems manufacturing has shifted overseas, so have many downstream customers and partner manufacturers. U.S. PCB manufacturers have been facing a diminishing domestic market while simultaneously finding it challenging to compete in foreign markets.

• As mass PCB production has shifted away from the U.S. towards Asia, so has the industry supply chain.
  - Many specialty PCB supply chain manufacturers derive their revenue from the square feet of board produced rather than from the value of the finished PCB. This has resulted in them following PCB production overseas.
  - Also, many in the sector have failed or merged with others in order to remain financially solvent.

• Forty-five percent of BIS survey respondents stated that a reduction in U.S. companies that manufacture laminate and other circuit-board related materials has created supply problems for them.

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Supply Chain: Operators Encountering Disruptions Since 2012

- Laminate - rigid conventional boards: 40
- Laminate - rigid high speed, high frequency, and microwave boards: 38
- Laminate - rigid multilayer boards: 33
- Copper foil: 21
- Laminate - rigid-flex boards: 16
- Laminate - flex boards: 16
- Through-hole and plating preparation for plating material: 14
- Etchant: 10
- Finish materials: 9
- Electrolytic plating material: 9
- Via fill, conductive, and non-conductive material: 8
- Drill bits: 7
- Solder mask: 7
- Solder: 6
- Other foils: 5
- Embedded passives, formed, resistors, and capacitors - tin-lead: 4
- Embedded passives, formed, resistors, and capacitors - lead-free: 3
- Other: 1

Source: U.S. Department of Commerce, Bureau of Industry and Security

202 respondents
Supply Chain Disruptions - Example

**Does a reduction in U.S.-based companies that manufacture laminates and other circuit board-related materials create supply problems for this facility?**

- **Yes**: 90 facilities
- **No**: 109 facilities

77% reported defense-related sales

**Top Experienced Material Supply Chain Disruptions Since 2012**

- Laminate - rigid conventional boards: 40 facilities
- Laminate - rigid high speed, high frequency, and microwave boards: 38 facilities
- Laminate - rigid multilayer boards: 33 facilities
- Copper foil: 21 facilities
- Laminate - rigid-flex boards: 16 facilities
- Laminate - flex boards: 16 facilities

**Suppliers Listed – Countries:**
- Laminate – rigid conventional board:
  - **United States**: 56%
  - **China**: 34%
  - **Taiwan**: 7%
  - **Japan**: 2%
  - **South Korea (ROK)**: 1%

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Supply Chain

• The ability to trace the source and origins of PCBs and other potentially critical components is a challenge for DoD

• Some DoD oversight and assessment of supply-chain capabilities are needed. Other USG agencies as well as industry needs to participate in this effort.

• **Recommendations/Potential actions:**
  - Work with DMEA (program manager for DoD Trusted Foundry program) on trusted supplier accreditation.
  - Package PCBs with Integrated Circuits into existing DMEA program and ongoing National Security Council semiconductors effort.
Employment - Challenges

- Thirty-six percent of BIS survey respondents reported current difficulties hiring and retaining employees.

- Top two key future workforce-related issues anticipated (2016-2020).
  - Finding experienced workers – 65% of respondents
  - Finding qualified workers – 52% of respondents

- Aging workforce and upcoming retirement is also an industry challenge.
  - 13% of technical staff (scientists, engineers, R&D staff) expected to retire by 2020.

- Comments from U.S. PCB manufacturers include:
  - “To expand we need qualified workers that just are not available”
  - “The biggest challenge is to find qualified candidates who would be a good match”
  - “Experienced workforce is aging, fewer new entrants to manufacturing”
  - “Harder to find circuit board related experience. We have to do 100% OTJ training”
  - “Much of the work in our industry has moved offshore affecting both local and US talent availability. It can be difficult to attract new talent in what is considered to be a diminishing market.”
  - “Many senior level employees leaving within the next 5 years.”
  - “Average age of 58.”
  - “Many workers over at or near retirement age.”
  - “Lower demand over the years led to workforce reductions instead of hiring. As a result existing workforce is the more experienced and now facing retirement age”
  - “Significant portion of our workforce will be retirement-eligible in 5-years”
  - “Anticipating large number of retirements in next five years; aging workforce”

Source: U.S. Department of Commerce, Bureau of Industry and Security
Industry Hiring and Retention Issues

Does this facility have difficulty hiring and/or retaining any types of employees?

- Yes, 73, 36%
- No, 88, 44%
- N/A, 41, 20%

U.S. Bare PCB Workforce: Key Issues Anticipated (2016-2020)

- Finding experienced workers: 132
- Finding qualified workers: 106
- Attracting workers to location: 62
- Employee turnover: 57
- Significant portion of workforce retiring: 57
- Finding U.S. citizens: 35
- Finding workers able to get security clearances: 16

Source: U.S. Department of Commerce, Bureau of Industry and Security

202 respondents
U.S. Bare PCB Workforce
- Hiring/Retention Difficulty by Job Category

Does this facility have difficulty hiring and/or retaining any types of employees?

![Bar chart showing hiring, retaining, and both difficulties for various job categories.](chart.png)

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Employment - Challenges

• The industry’s ability to recruit and hire a qualified sustainable workforce seems to be limited by two key factors.
   Shortage of prospective employees who have the essential skills needed to be successful in a PCB manufacturing capacity.
   A general shortage of young people interested in manufacturing careers in general.

• These are exacerbated by the impression that U.S. PCB manufacturing is a diminishing industry.

• Many manufacturing companies are facing seemingly contradictory goals in order to remain competitive - a need both to cut workforce costs and at the same time to invest in the workforce so that it can do more.

• Recommendations:
   Address the skill gaps in the industry’s labor market by working with academic institutions to develop and grow technical education workforce development programs such as internships, apprenticeships, tuition reimbursements, etc.
   Community colleges can have a critical role to play because they understand the needs of local employers, and can design programs and courses that are responsive to local employers’ needs.

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
Views on Potential USG Bare PCB Actions

What impact would each of the following potential USG actions have on your business?

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Benefit</th>
<th>Harm</th>
<th>No Change</th>
<th>Unclear</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirement that Electronic Systems use US manufactured boards</td>
<td>168</td>
<td>2</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Requirement for defense systems boards manufactured in the U.S. by &quot;trusted&quot; suppliers</td>
<td>148</td>
<td>6</td>
<td>19</td>
<td>29</td>
</tr>
<tr>
<td>Critical Systems Boards Produced in U.S.A.</td>
<td>117</td>
<td>13</td>
<td>27</td>
<td>45</td>
</tr>
<tr>
<td>Increased Funding of targeted PCB Manufacturing tech R&amp;D</td>
<td>117</td>
<td>1</td>
<td>44</td>
<td>40</td>
</tr>
<tr>
<td>Requirement for Defense Systems Product Manufacturers Registered on QML/QPL</td>
<td>115</td>
<td>14</td>
<td>26</td>
<td>47</td>
</tr>
<tr>
<td>DOD adds circuit board laminate and related materials to the Defense National Stockpile</td>
<td>72</td>
<td>6</td>
<td>55</td>
<td>67</td>
</tr>
</tbody>
</table>

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified

Q12c,A

202 respondents
U.S. PCB Industry Interest in U.S. Government Outreach

Top Areas of Outreach Interest

- Market Expansion/Business Growth: 89 facilities
- Government Procurement Guidelines: 64 facilities
- Continuous Improvement/Lean Manufacturing: 63 facilities
- Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) contracts: 59 facilities
- Prototyping: 56 facilities
- Technology Acceleration: 54 facilities
- Quality Management and Control: 51 facilities
- Cyber Security: 50 facilities
- Design for Manufacturability: 49 facilities
- Energy and Environmentally Conscious Manufacturing: 45 facilities

Source: U.S. Department of Commerce, Bureau of Industry and Security
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified
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Source: U.S. Department of Commerce, Bureau of Industry and Security  
U.S. Bare Printed Circuit Board Industry Assessment - 2017 - Unclassified