



Highlights of IPC's 2018 PCB Technology Trends Study

Wisdom Wednesday Webinar for IPC Members

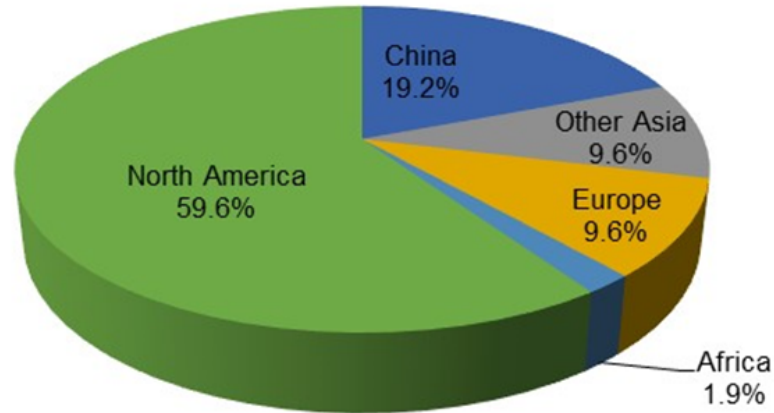
February 20, 2019

Scope of the 2018 Study

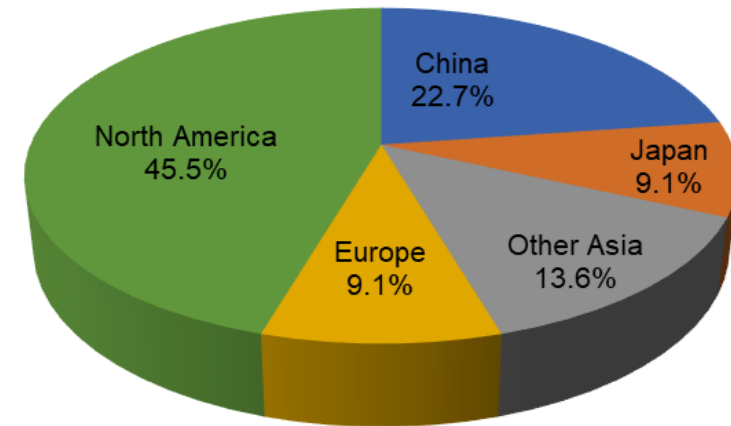
- ❖ 74 companies worldwide participated in the 2018 study.
- ❖ 52 electronics OEMs supplied data about their use of emerging technologies and their technical requirements for PCBs in 2018 and their predictions for 2023.
- ❖ 22 PCB fabricators reported on technology issues in PCB fabrication and technical capabilities as of 2018 and their predictions for 2023.
- ❖ The results provide insight on the current status of PCB fabricators' ability to meet OEMs' requirements, and how these capabilities will need to evolve over the next five years.

Participant Demographics

Geographic Distribution of Participating OEMs



Geographic Distribution of Participating PCB Companies



❖ Geographic distribution reflects IPC's member base

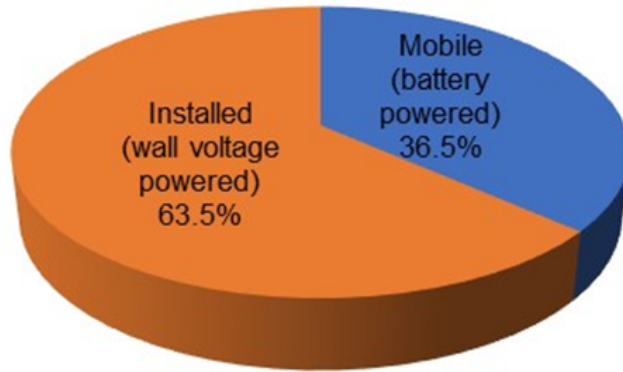
- ❖ North America heavily represented
- ❖ All regions represented

❖ Results are segmented in two broad regions:

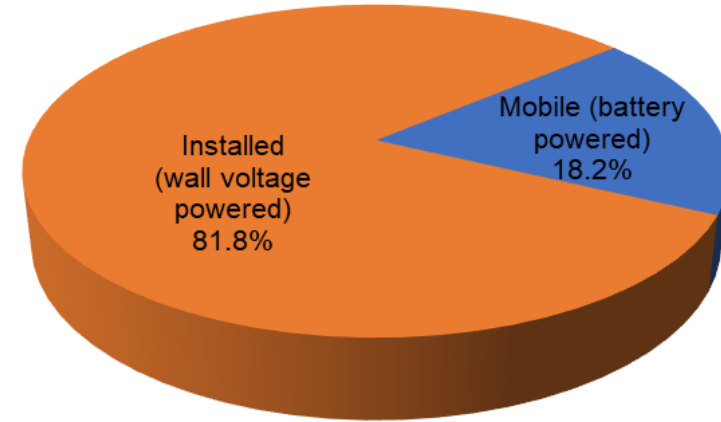
- ❖ North America & Europe
- ❖ Asia and Africa

Primary Applications

Primary End-Product Type for Participating OEMs:
Mobile versus Installed



Primary End-Product Type for PCBs Produced by
the Participating PCB Companies:
Mobile versus Installed



- ❖ Most participants identified installed products as their primary product type.
- ❖ The results are segmented by product type:
 - ❖ Installed products (wall voltage powered)
 - ❖ Mobile devices (battery powered)

Technical Advisors

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SELECTED FINDINGS

OEMs' Use of Emerging Technologies

❖ Internet of Things (IoT)

- ❖ More than half of the surveyed OEMs are making products today that communicate with the IoT.
- ❖ Two-thirds expect to by 2023.

❖ Artificial Intelligence (AI)

- ❖ More than one-third of OEMs are making products that incorporate AI today.
- ❖ More than half expect to do so by 2023.

❖ Sensors

- ❖ Three-quarters of the OEMs already make products that depend on sensor inputs.
- ❖ More will be using sensor inputs by 2023.

❖ Neural Networks

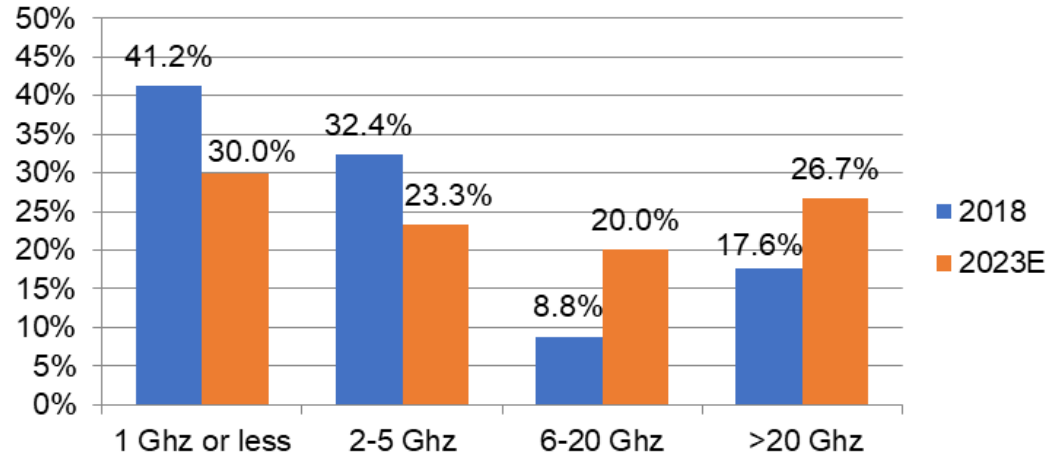
- ❖ Some OEMs are making products that interface with humans by way of neural networks
- ❖ More than one-third expect to incorporate this technology by 2023.

OEMs' Product Requirements

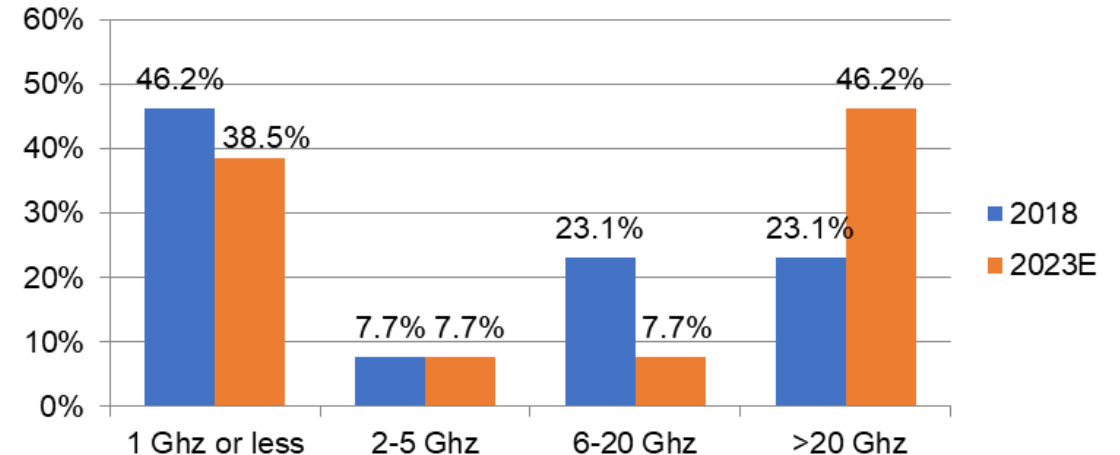


Maximum Frequency

Maximum Frequency at Which Participating OEMs' Products Need to Operate in Gigahertz (Percent of Responses) - North America and Europe

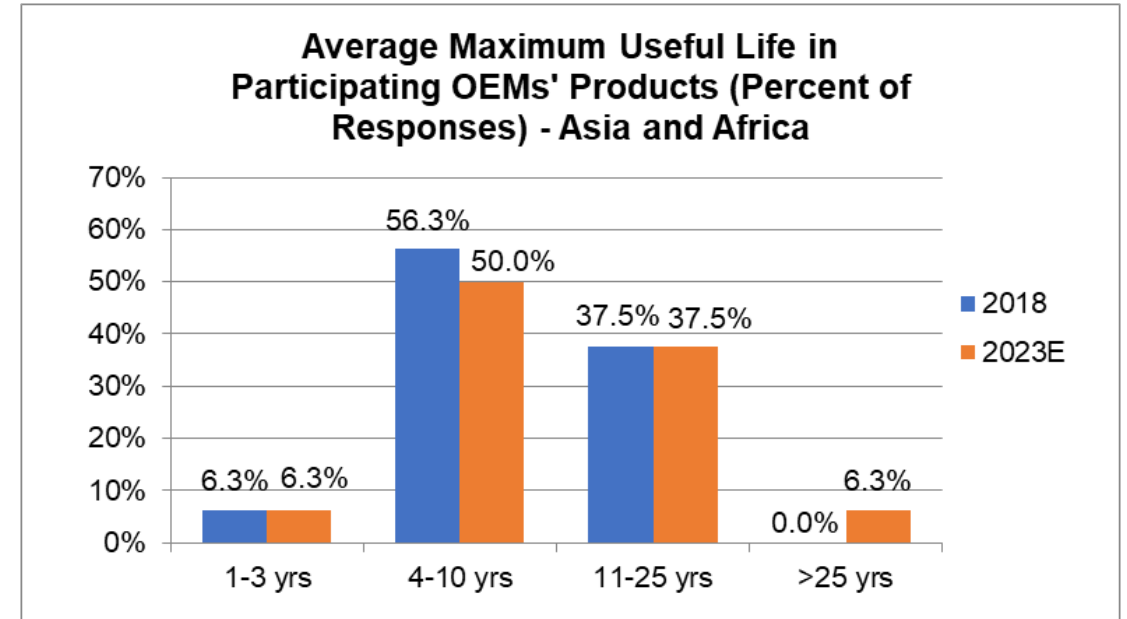
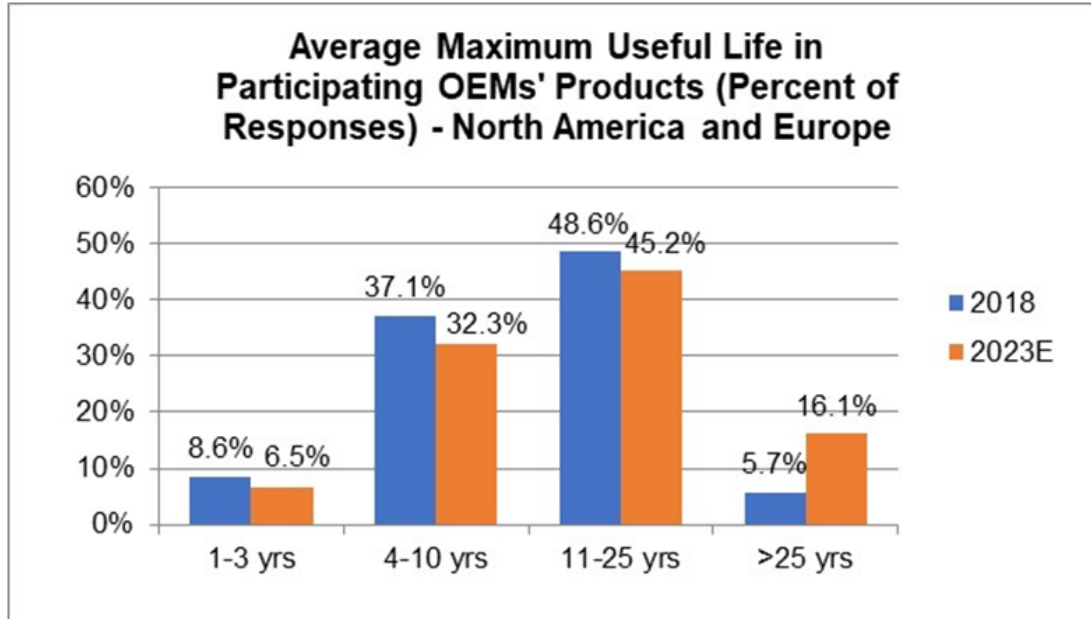


Maximum Frequency at Which Participating OEMs' Products Need to Operate in Gigahertz (Percent of Responses) - Asia and Africa



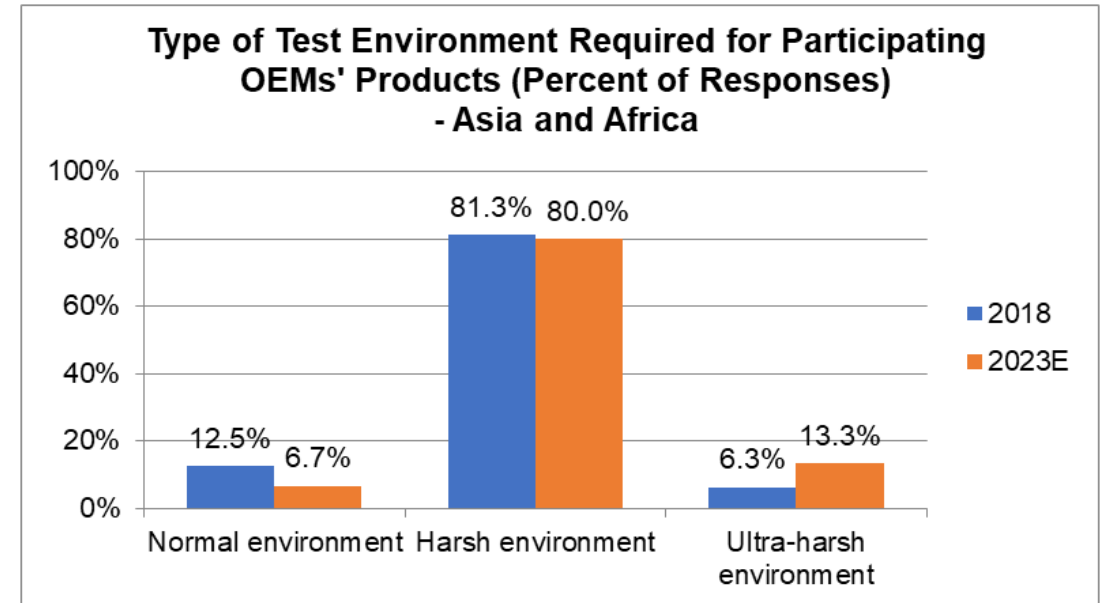
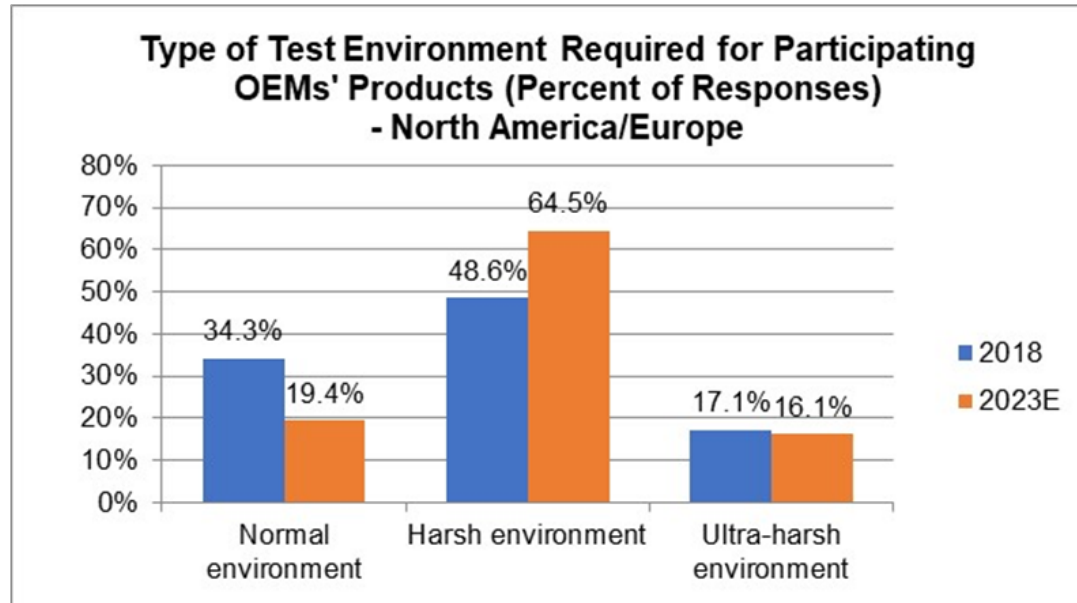
- ❖ The maximum frequency at which OEMs' products need to operate is expected to increase.
- ❖ The biggest increase is expected by OEMs in Asia where almost half of OEMs expect their maximum frequency to exceed 20 gigahertz by 2023.

Maximum Useful Product Life



- ❖ The maximum life expectancy of OEMs products is expected to increase.
- ❖ The participating OEMs in Asia and Africa currently produce no products with a life expectancy of >25 years, but some expect to do so in the next five years.

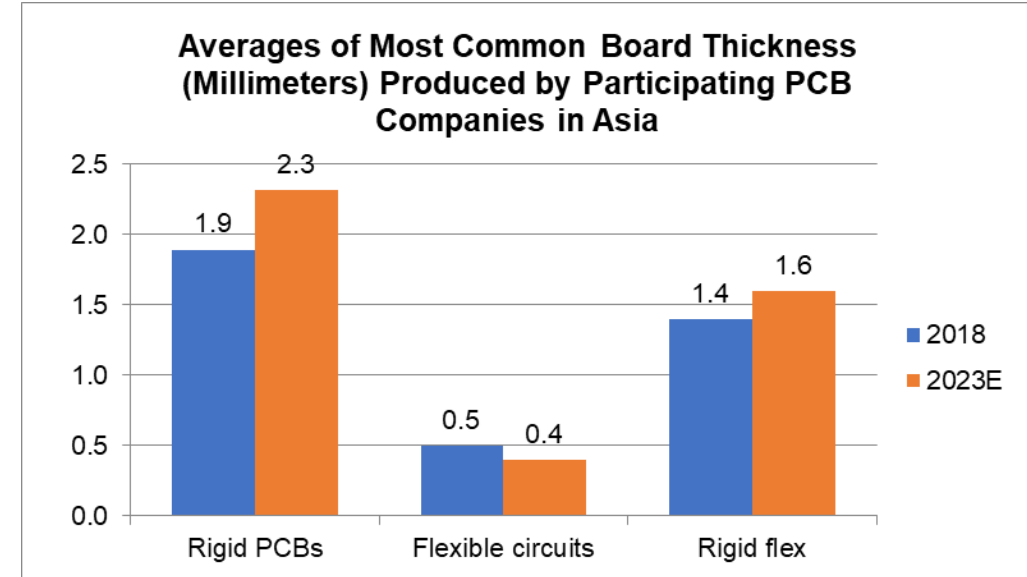
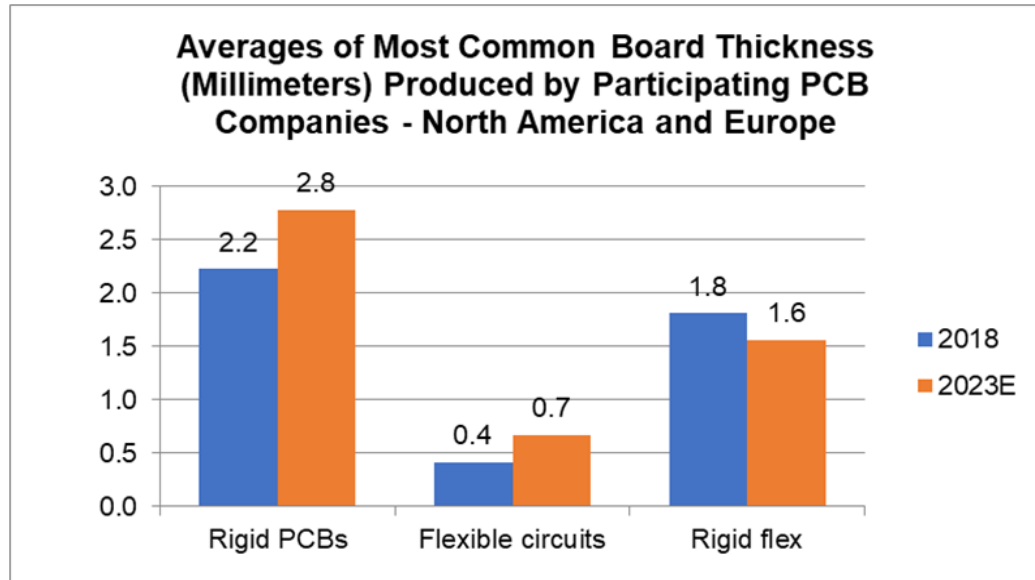
Test Environment



- ❖ More OEMs in North America and Europe expect to design products for harsh environments by 2023.
- ❖ For OEMs in Asia, more products for ultra-harsh environments are anticipated.
- ❖ The need for testing in normal environments is seen decreasing in both regions.

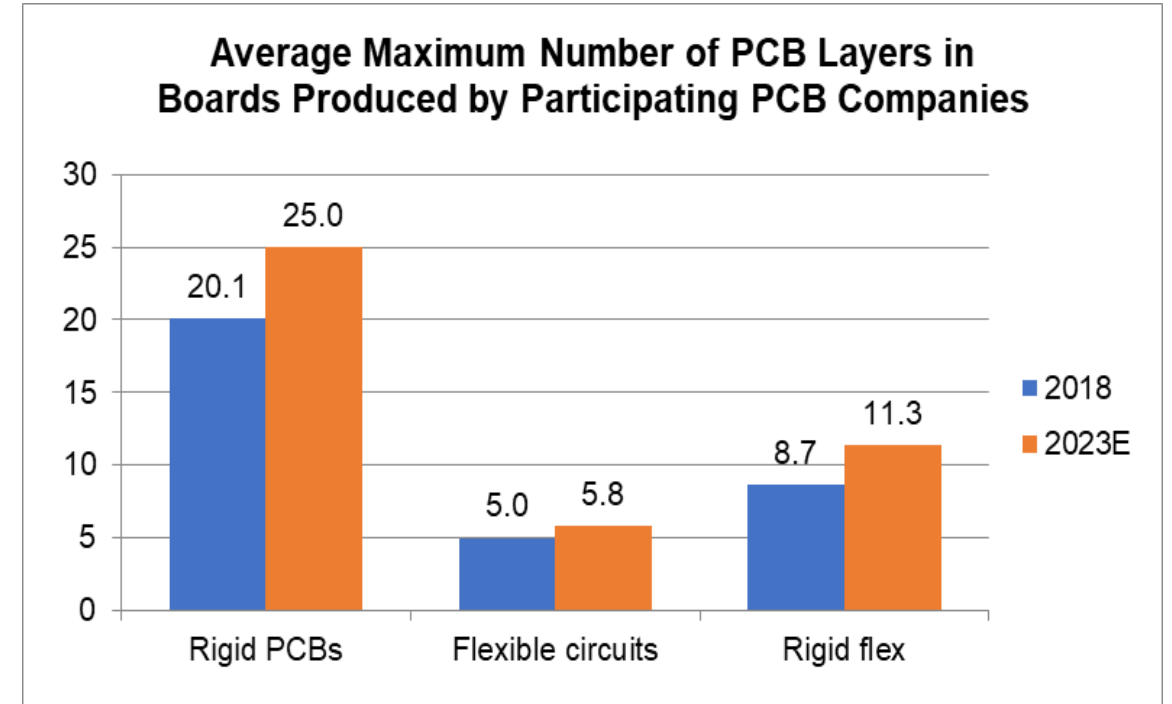
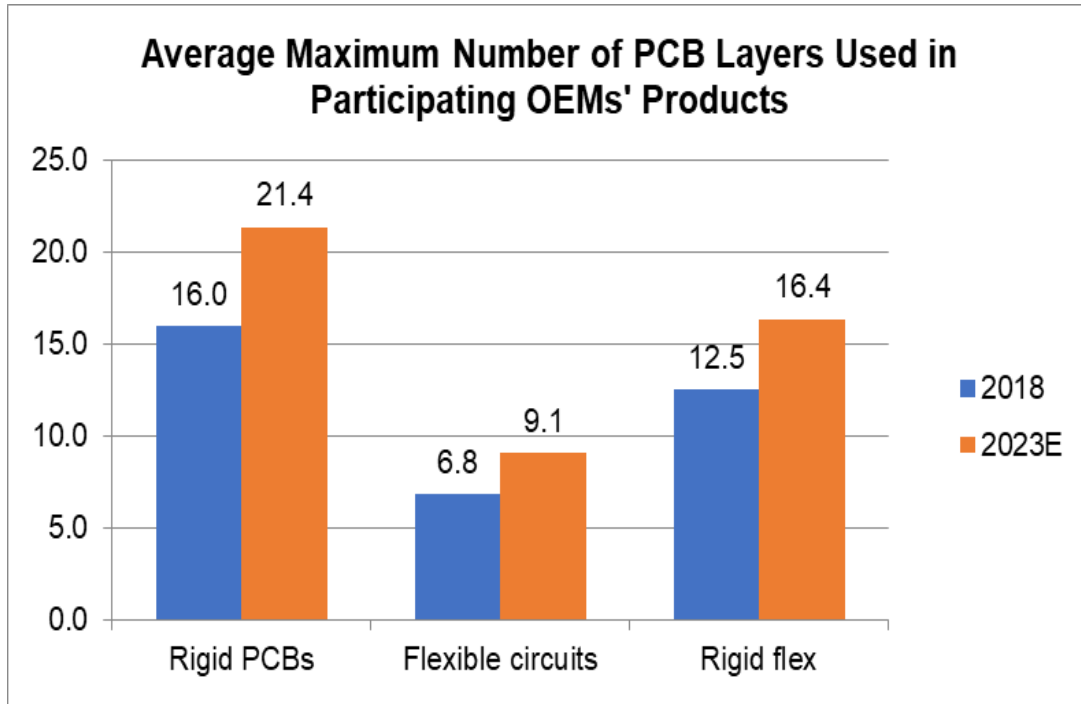
PCB Requirements

Most Common Board Thickness



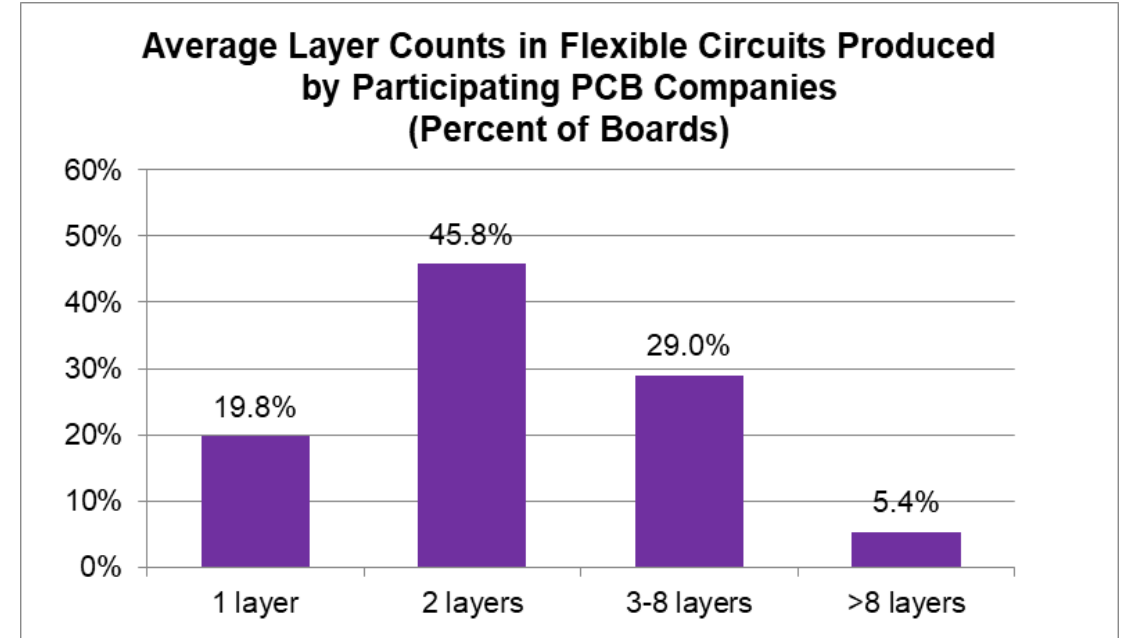
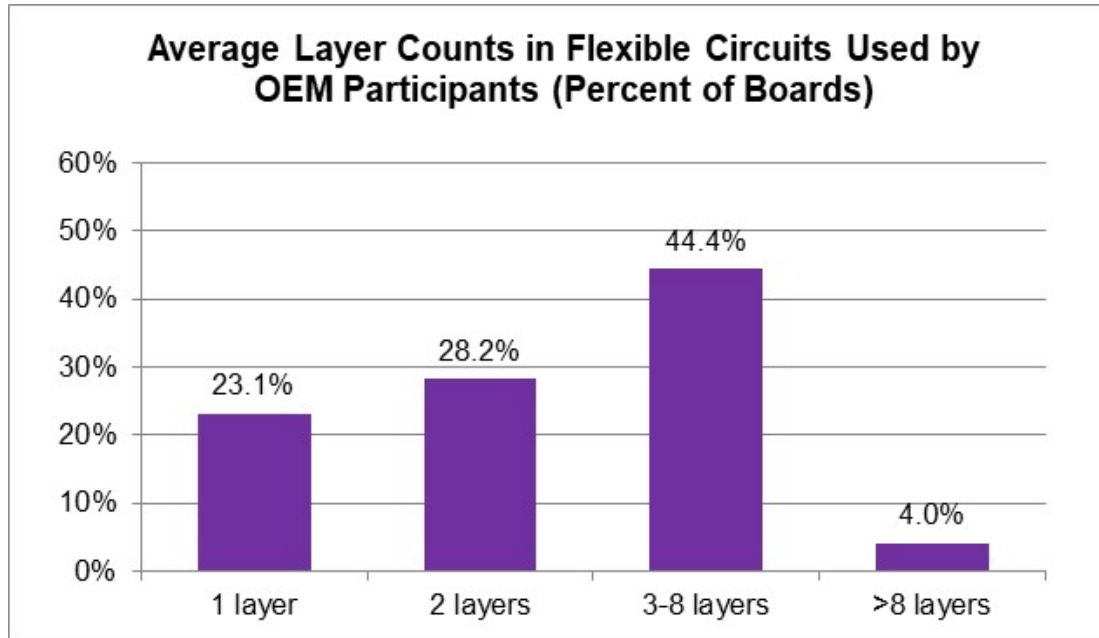
- ❖ OEMs and PCB fabricators in both regions anticipate increases in rigid board thickness.
- ❖ Predictions about flexible circuits and rigid flex are mixed.
 - ❖ PCB fabricators in North America and Europe expect flexible circuits to increase in thickness and rigid flex to decrease slightly. Asian fabricators predict the reverse.
 - ❖ OEMs in Asia expect reductions in flex and rigid flex thickness.

Maximum Layer Count



- ❖ OEMs and PCB fabricators both predict increases in maximum layer counts for all types of boards.
- ❖ The regional segments reflect similar expectations.

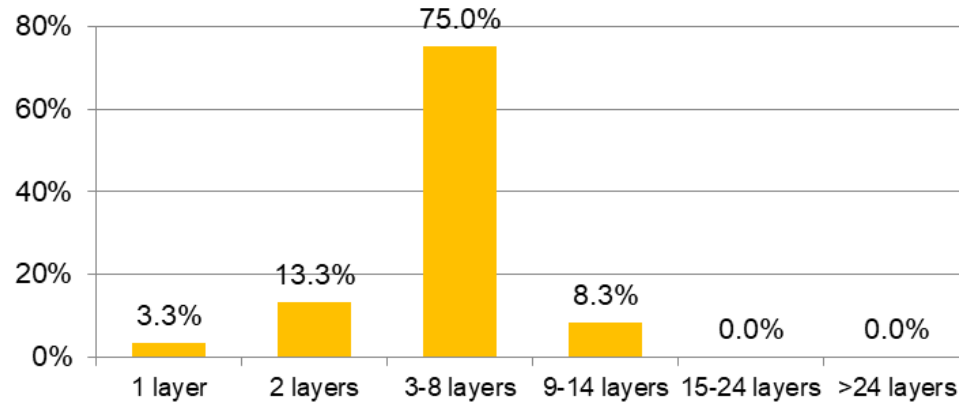
Current Average Layer Counts: Flexible Circuits



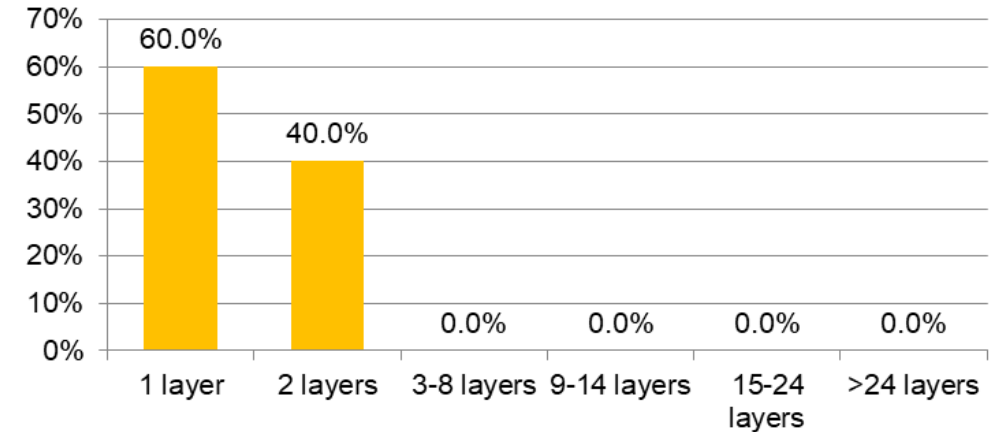
- ❖ OEMs most often cited 3-8 layers as the average layer count in the flexible circuits they use.
- ❖ PCB fabricators cited 2 layers as the most common layer count in their flexible circuits.
- ❖ OEMs and PCB fabricators agreed on the most common average layer counts for rigid PCBs and rigid flex (3-8 layers for both).

Current Average Layer Counts: Rigid Flex

Average Layer Counts in Rigid Flex Circuits
Produced by Participating PCB Companies
(Percent of Boards) - North America and Europe



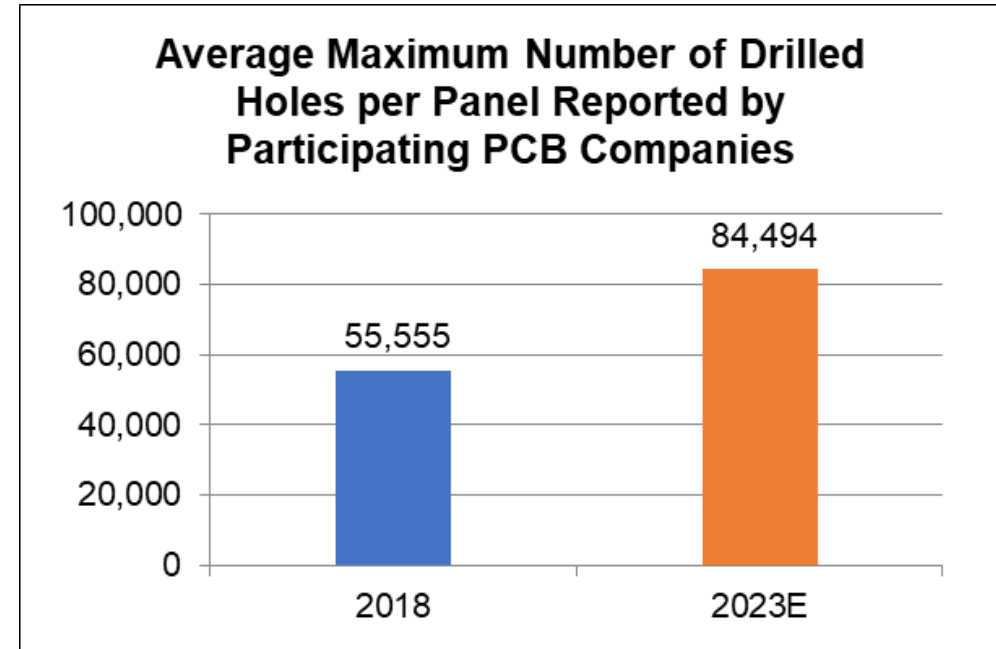
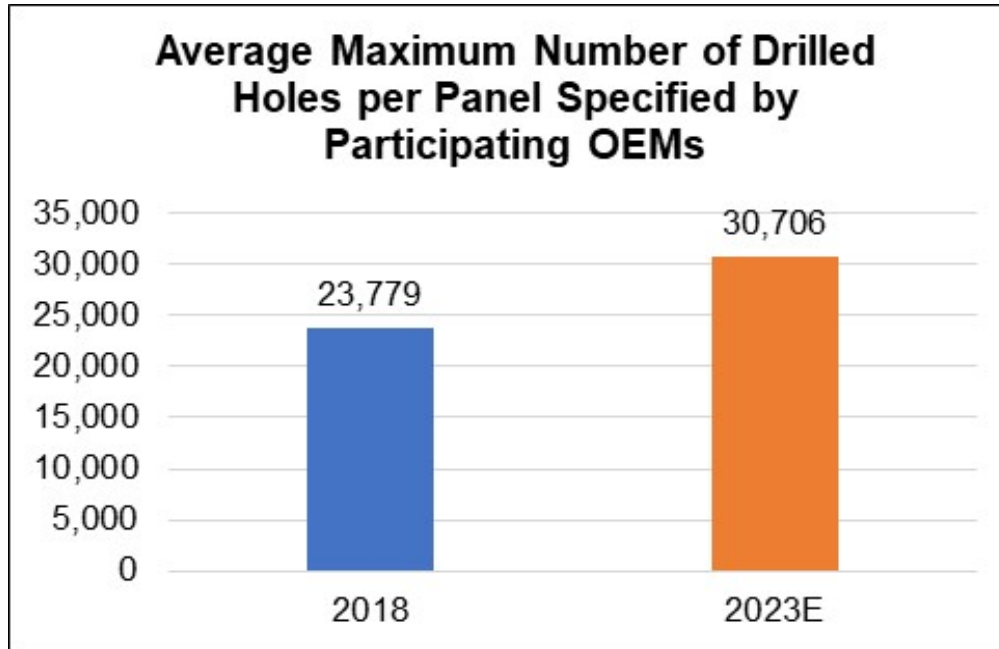
Average Layer Counts in Rigid Flex Circuits
Produced by Participating PCB Companies
(Percent of Boards) - Asia



❖ While OEMs and PCB fabricators agreed on average layer counts for rigid flex circuits, the fabricators reported distinctly different results by region.

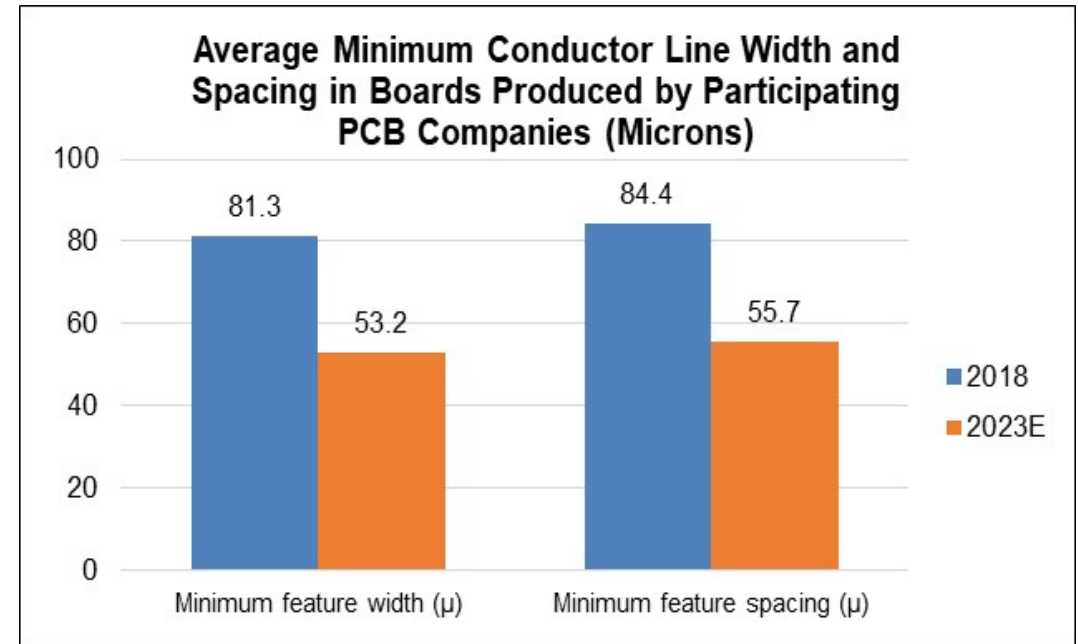
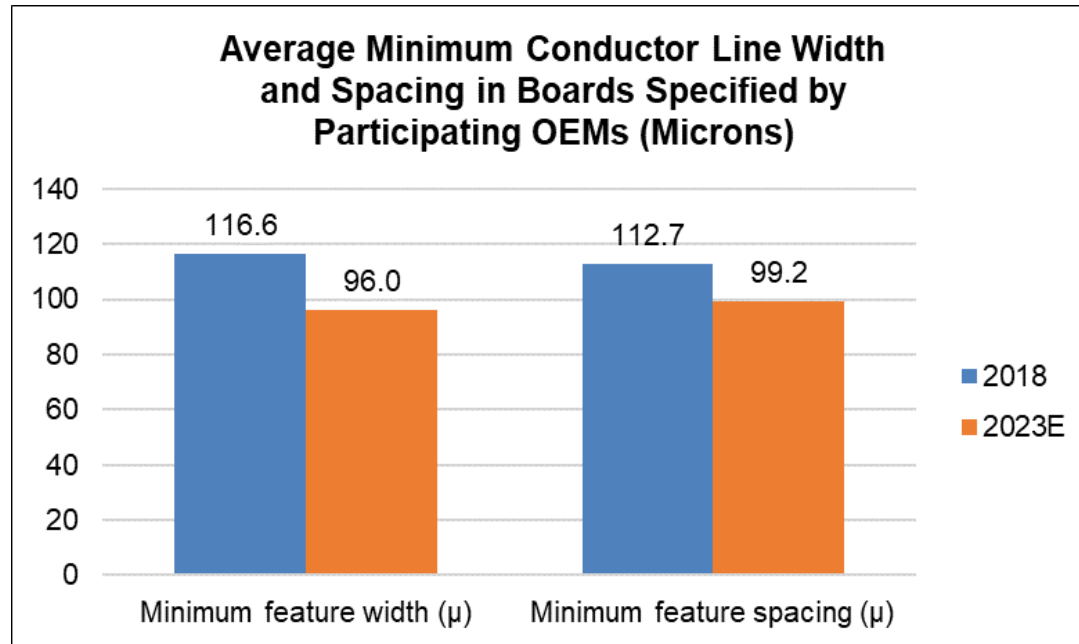
- ❖ Three-quarters of the fabricators in North America and Europe said 3-8 layers is the most common average layer count.
- ❖ Fabricators in Asia cited 1 layer as most common followed by 2 layers

Maximum Number of Drilled Holes per Panel



- ❖ Both OEMs and PCB fabricators expect the number of drilled holes per panel to increase substantially by 2023.
- ❖ The participating fabricators are more than capable of producing boards with the number of holes per panel that OEMs are specifying.
- ❖ Fabricators in Asia cited much higher numbers than those in North America and Europe.

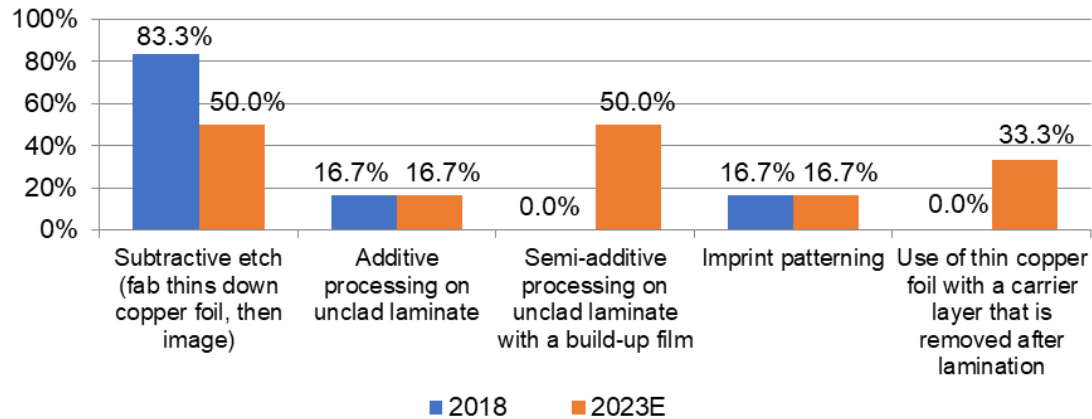
Line Width and Spacing



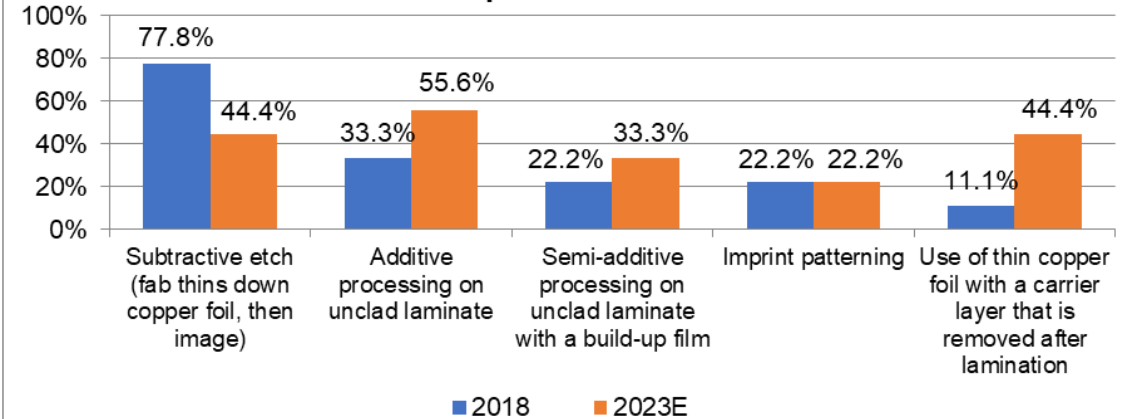
- ❖ Both OEMs and PCB fabricators expect line width and spacing to continue decreasing through 2023.
- ❖ The participating fabricators predict greater decreases than the OEMs.
- ❖ There were no significant differences between the regions.

PCB Fabrication Processes

Average Percentages of Participating PCB Companies Using Specific Processes to Achieve Very Fine Lines and Spaces in North America and Europe

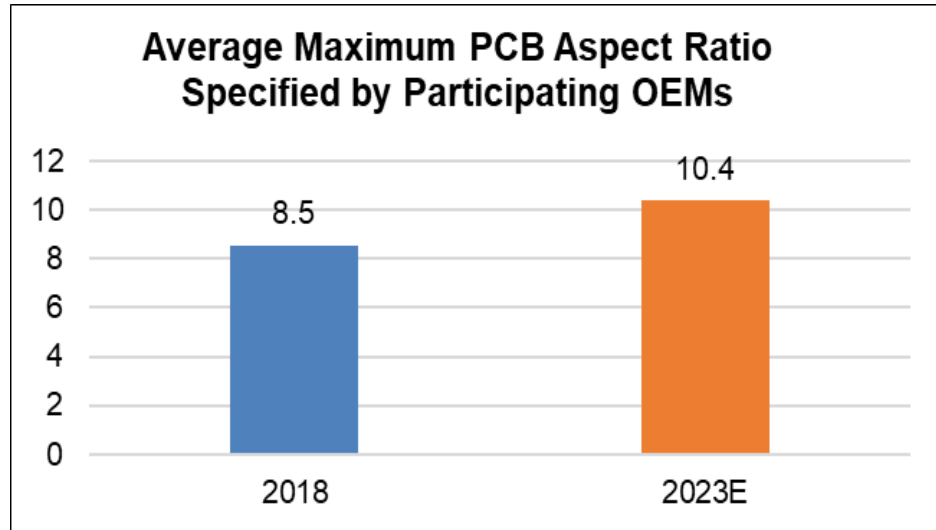


Average Percentages of Participating PCB Companies Using Specific Processes to Achieve Very Fine Lines and Spaces in Asia

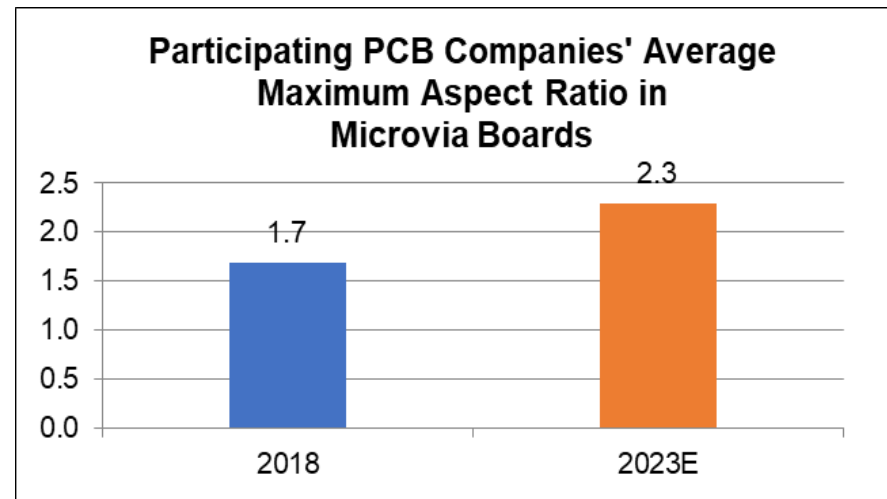
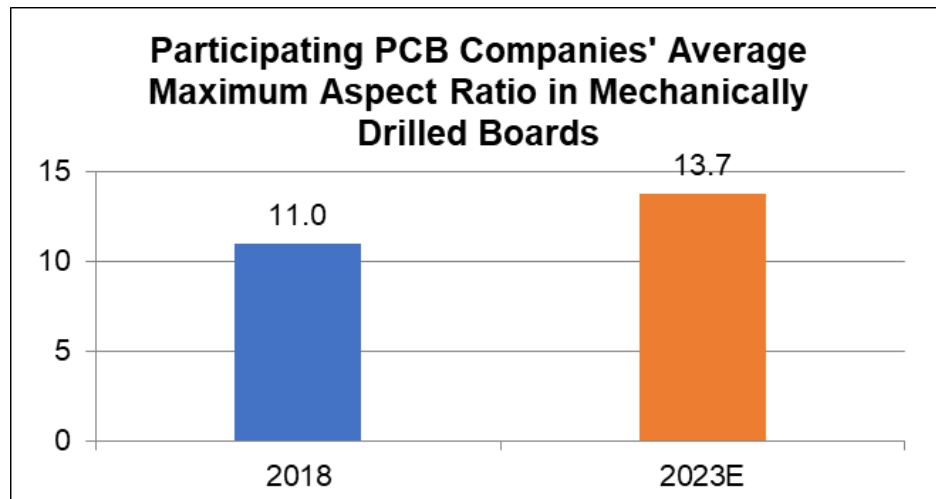


- ❖ PCB fabricators in both regions use mostly subtractive etch processes to achieve very fine lines and spaces today and both regions expect it to decrease in the next 5 years.
- ❖ Fabricators in both regions predict increasing use of semi-additive processing and thin copper foil with a carrier layer.
- ❖ Fabricators in Asia also expect to use more additive processing.

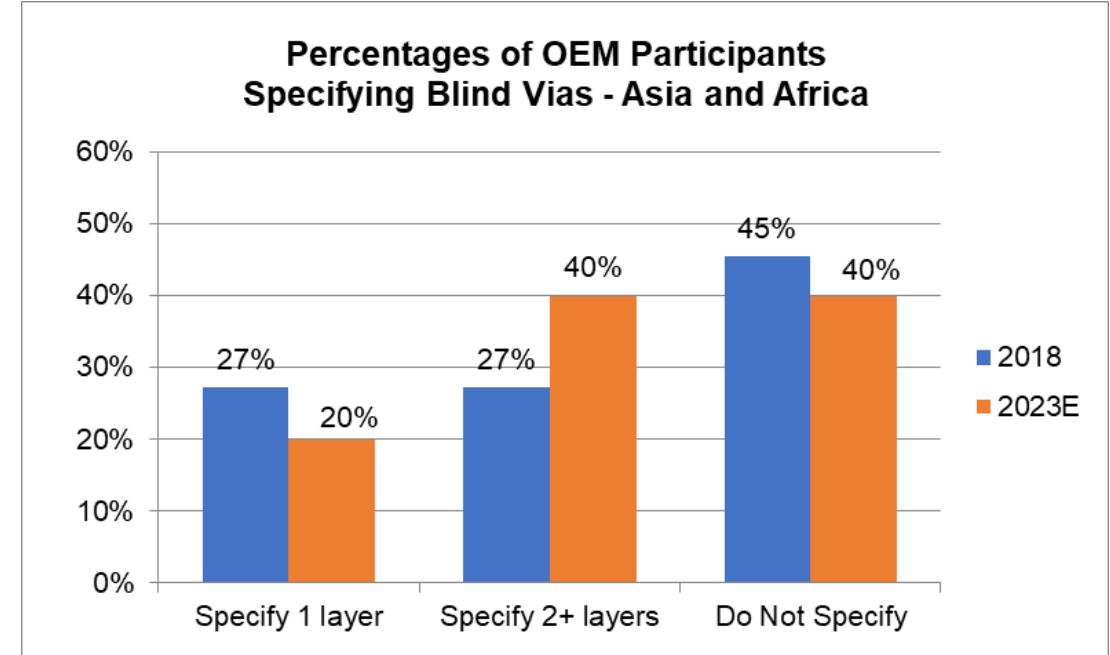
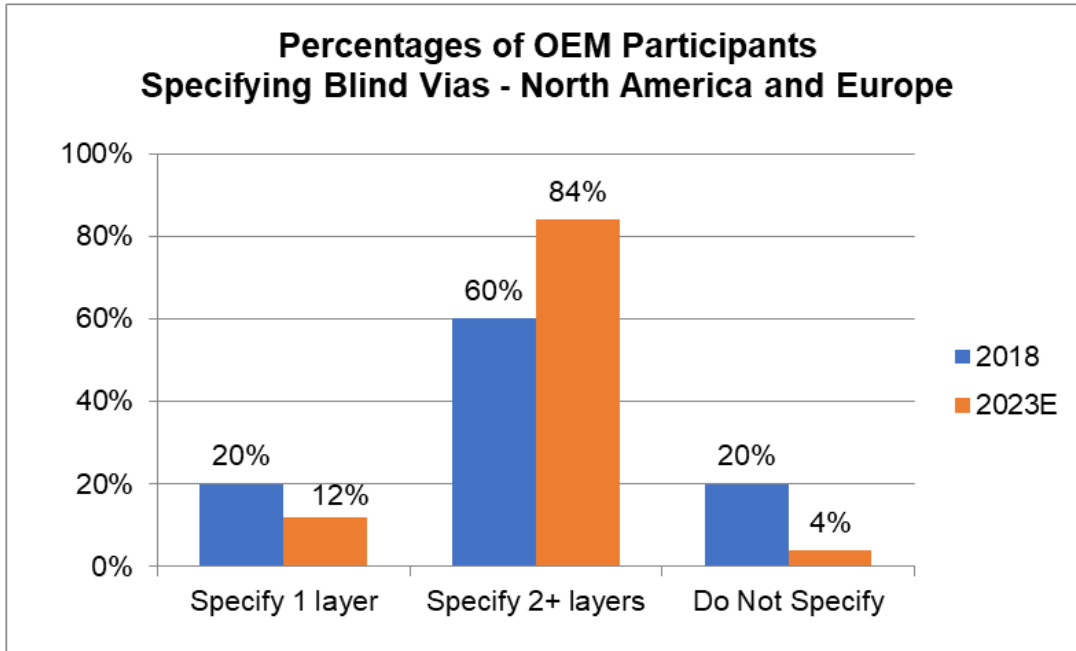
Maximum Aspect Ratios



- ❖ OEMs and PCB fabricators both predict increases in maximum aspect ratios over the next 5 years.
- ❖ No significant difference was noted between regions.

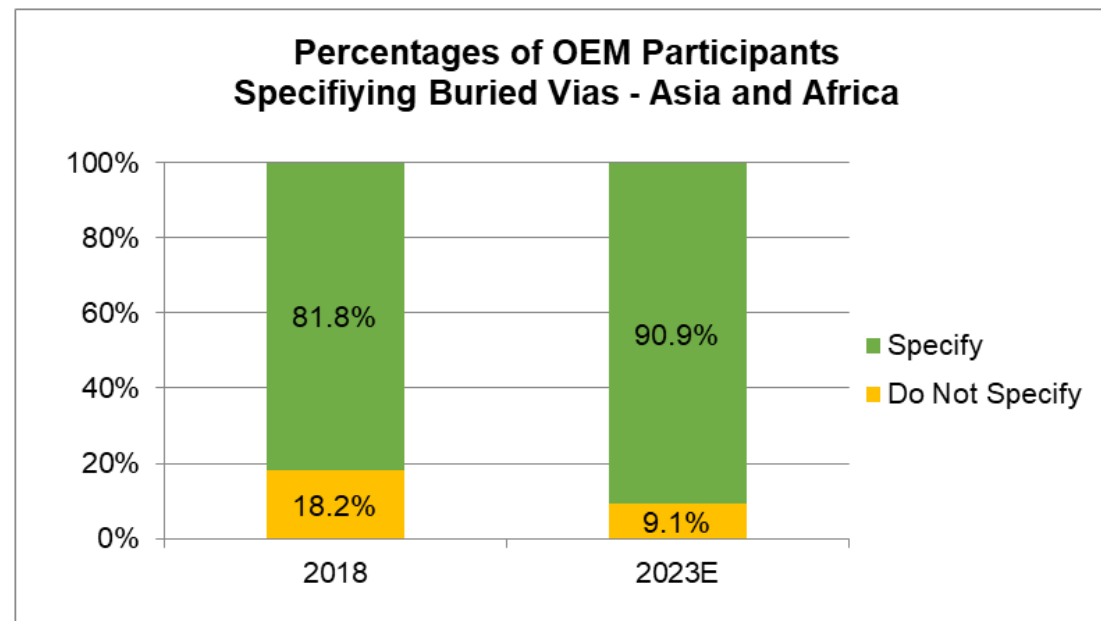
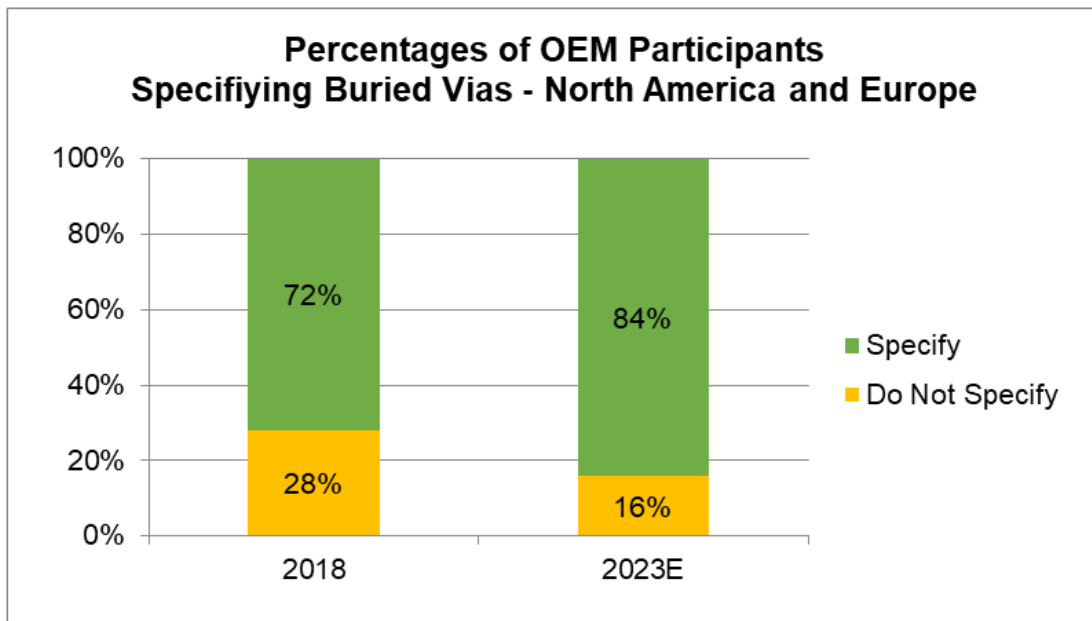


Blind Vias Specified by OEMs



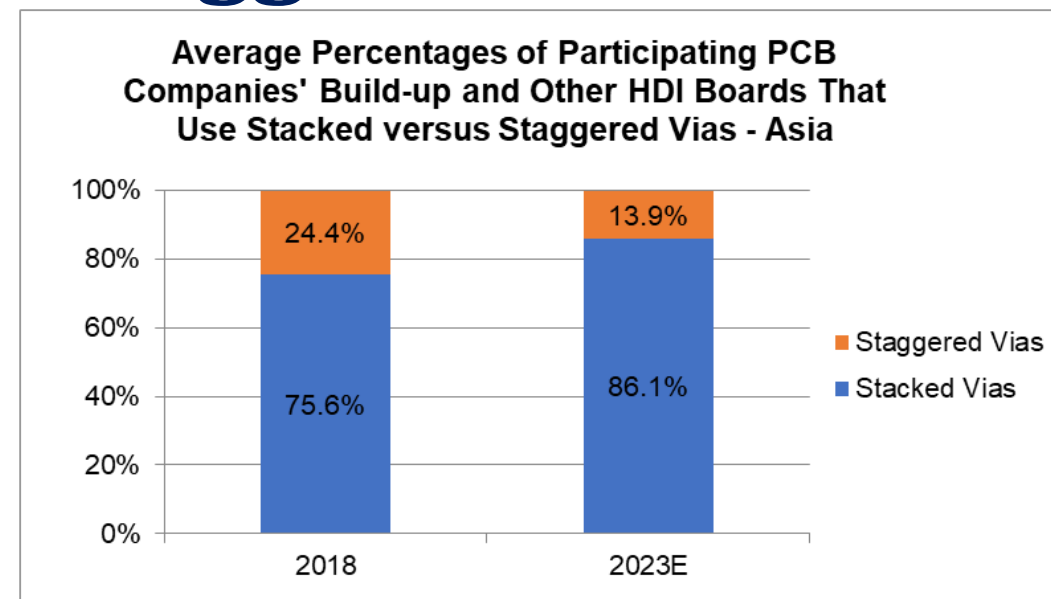
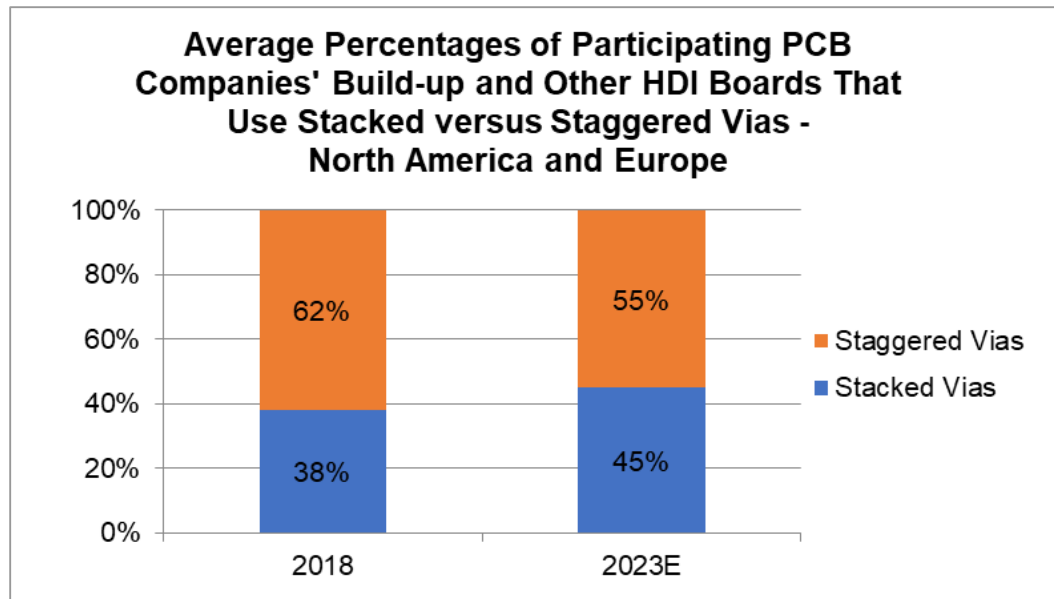
- ❖ OEMs in both regions expect their use of blind vias with 2 or more layers to increase in the next 5 years.
- ❖ A much higher percentage of OEMs in Asia and Africa do not specify blind vias and most expect that to continue.
- ❖ By contrast, 80% of the OEMs in North America and Europe do specify blind vias and almost all expect to by 2023.

Buried Vias Specified by OEMs



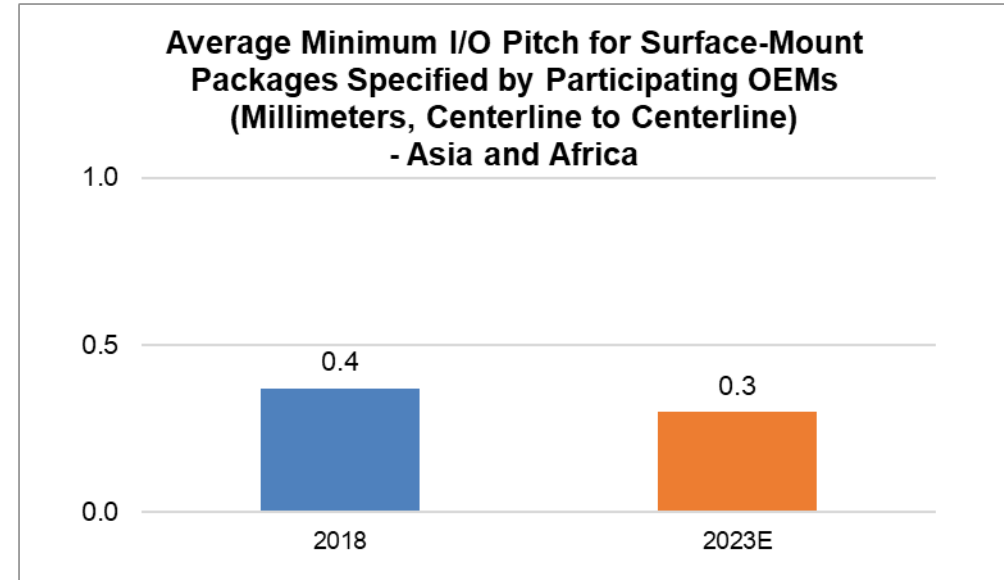
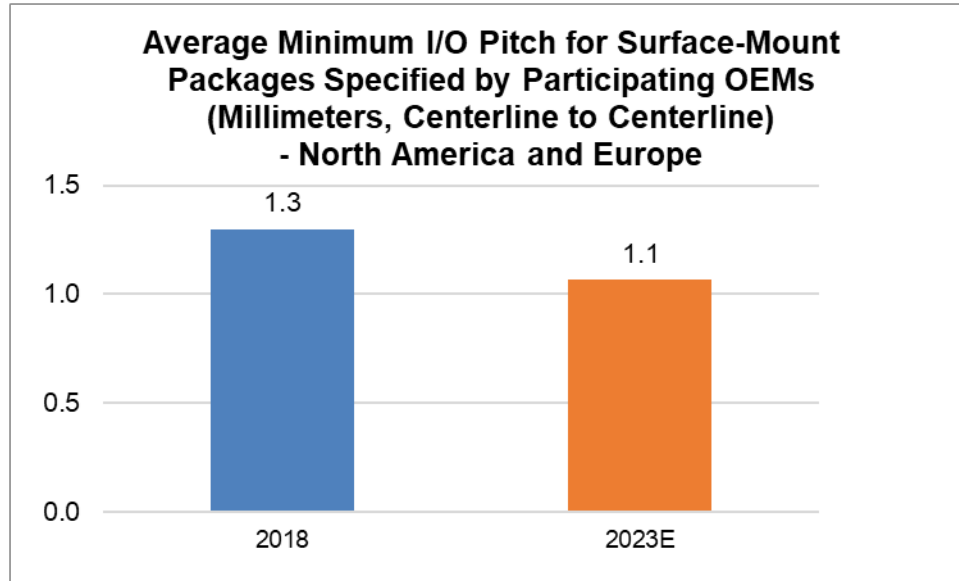
- ❖ OEMs in the two regions are similar in their use of buried vias.
- ❖ A high percentage of the participating OEMs specify buried vias today and more expect to do so by 2023.
- ❖ PCB fabricators in both regions report a similarly high use of buried vias in their boards.

Stacked versus Staggered Vias



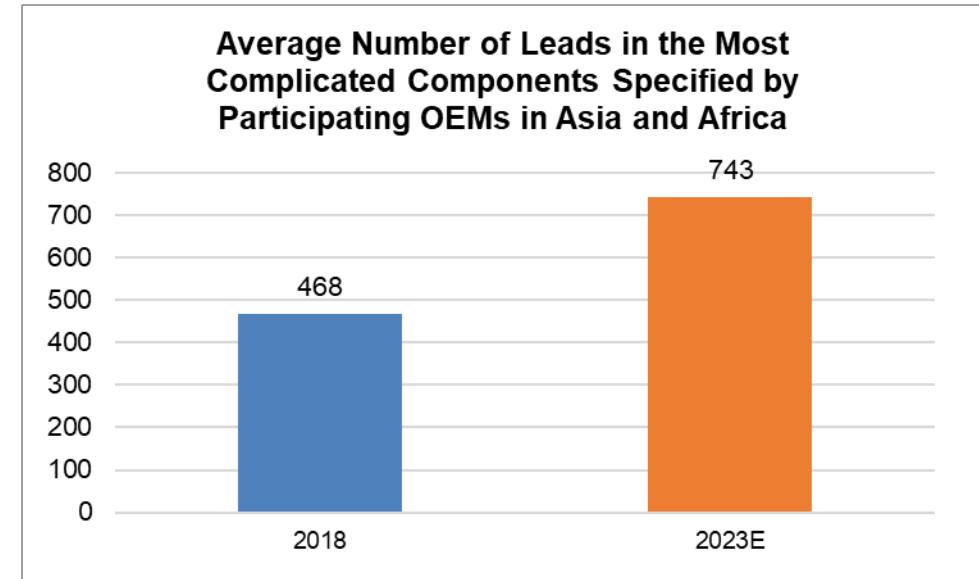
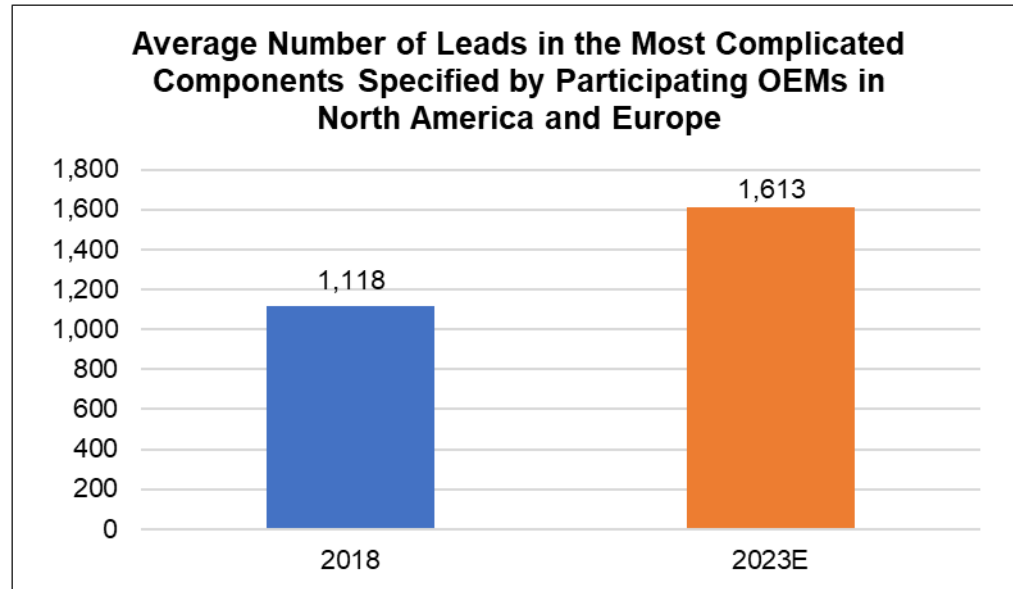
- ❖ PCB fabricators in North America and Europe report most boards have staggered vias.
- ❖ Among fabricators in Asia, most boards have stacked vias.
- ❖ Fabricators in both regions anticipate greater use of stacked vias over the next 5 years.
- ❖ Most fabricators in both regions report maximums of 1 to 4 microvia stacks.

Minimum I/O Pitch



- ❖ OEMs in Asia report substantially smaller minimum I/O pitch, on average, than fabricators in North America and Europe.
- ❖ OEMs in both regions expect minimum I/O pitch to decrease slightly.
- ❖ Participating PCB fabricators also predict decreasing I/O pitch.

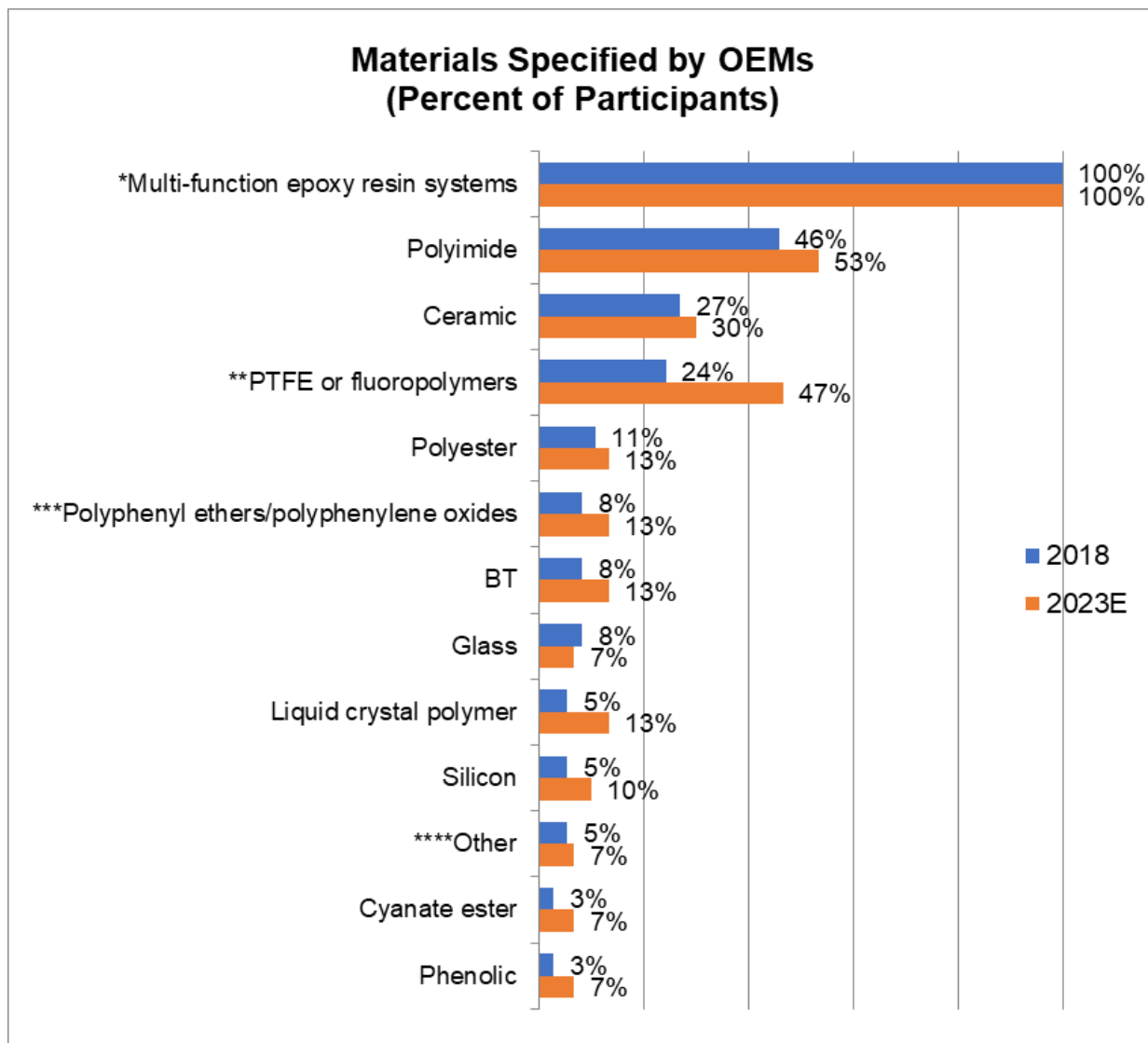
Number of Leads in Most Complex Part



- ❖ OEMs in North America and Europe reported a much larger number of leads in their most complicated component, on average, than OEMs in Asia.
- ❖ OEMs in both regions expect the number of leads to increase over the next 5 years.

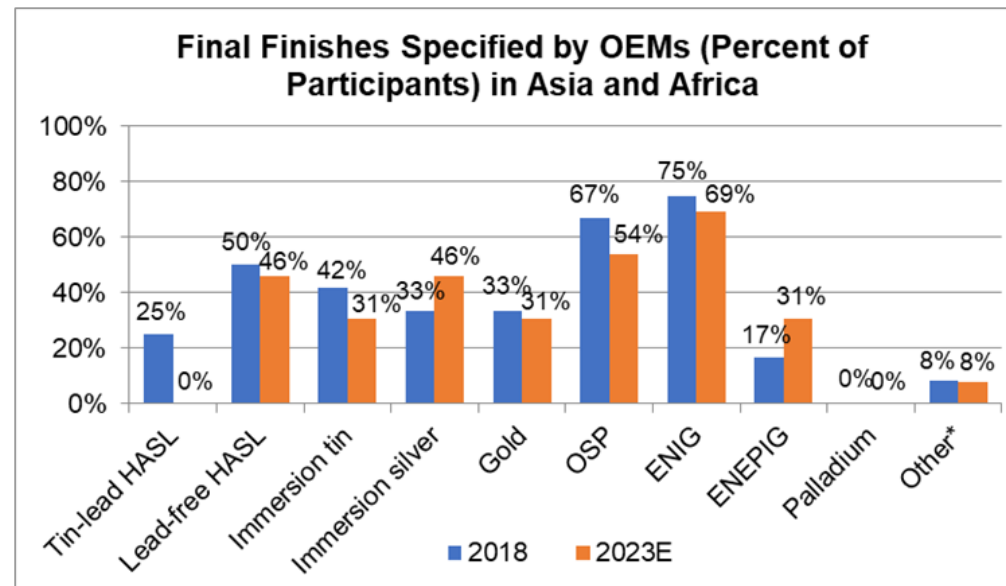
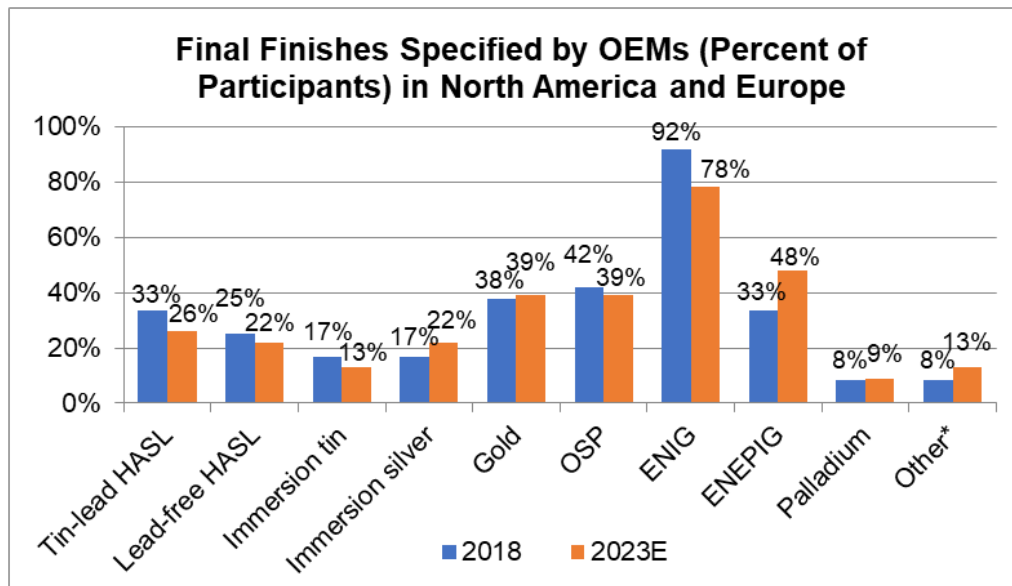
Materials

Substrate Materials Specified by OEMs



- ❖ OEMs, on average, expect to specify more polyimide, PTFE or fluoropolymer and many other materials in place of FR-4 in the next 5 years, but FR-4 will continue to be widely used.
- ❖ A higher proportion of OEMs in Asia specify ceramic, BT, glass, polyester and silicon materials than OEMs in North America and Europe.

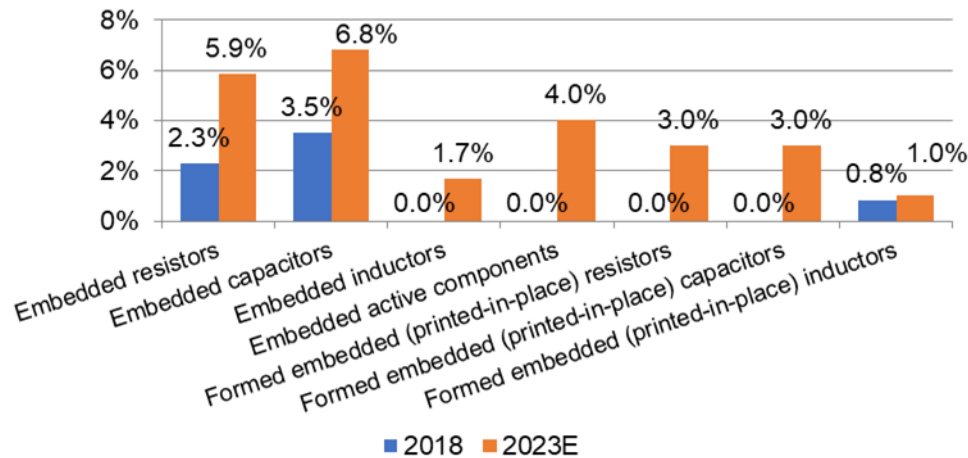
OEMs' Use of Final Finishes



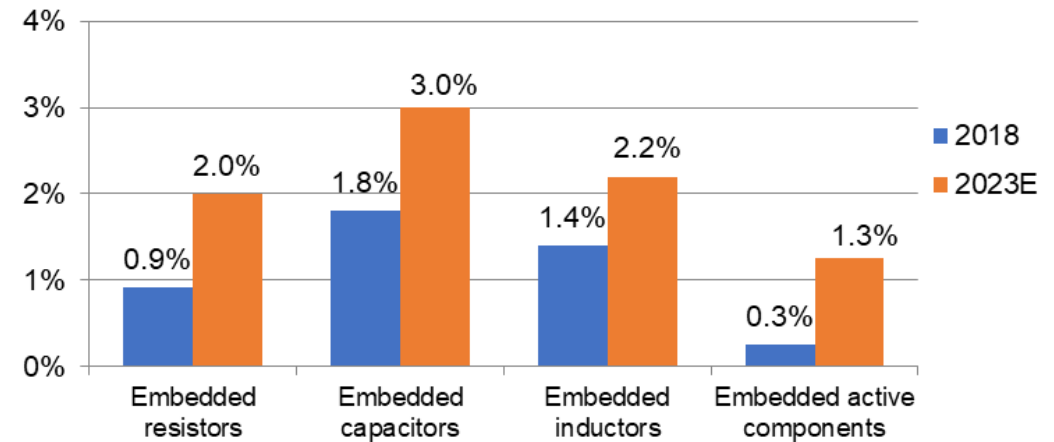
- ❖ Most OEMs in both regions specify ENIG.
- ❖ More OEMs in Asia reported that they specify OSP, lead-free HASL and immersion tin than OEMs in North America and Europe.
- ❖ More OEMs in North America and Europe said they specify tin-lead HASL and ENEPIG than those in Asia.
- ❖ OEMs in both regions expect to specify more ENEPIG and immersion silver in the next 5 years.

PCBs with Embedded Components

Participating PCB Companies' Average Percentages of PCBs Containing Embedded Components - North America/Europe



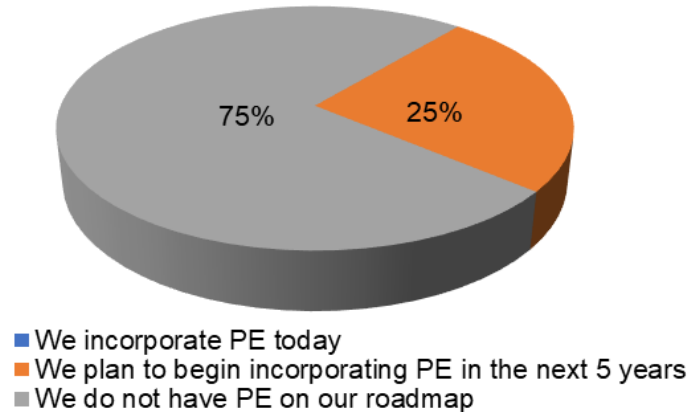
Participating PCB Companies' Average Percentages of PCBs Containing Embedded Components - Asia



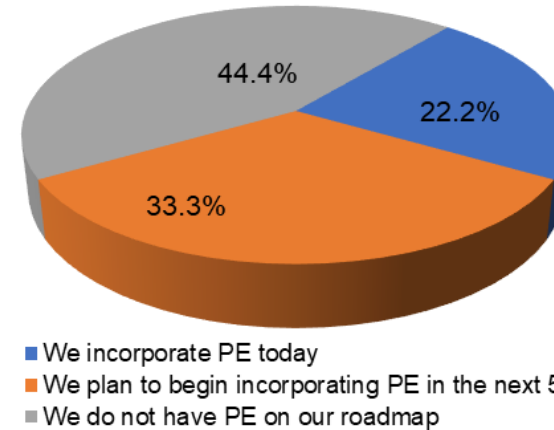
- ❖ PCB fabricators in both regions predict growing use of embedding in PCB production over the next 5 years, although the proportion of boards with embedded components will remain small.
- ❖ PCB fabricators in Asia do not predict any use of formed embedded (printed-in-place) components in the near future.

Use of Printed Electronics

Use of Printed Electronics (PE) or Hybrid PE by Participating PCB Companies (Percent of Participants) in North America and Europe

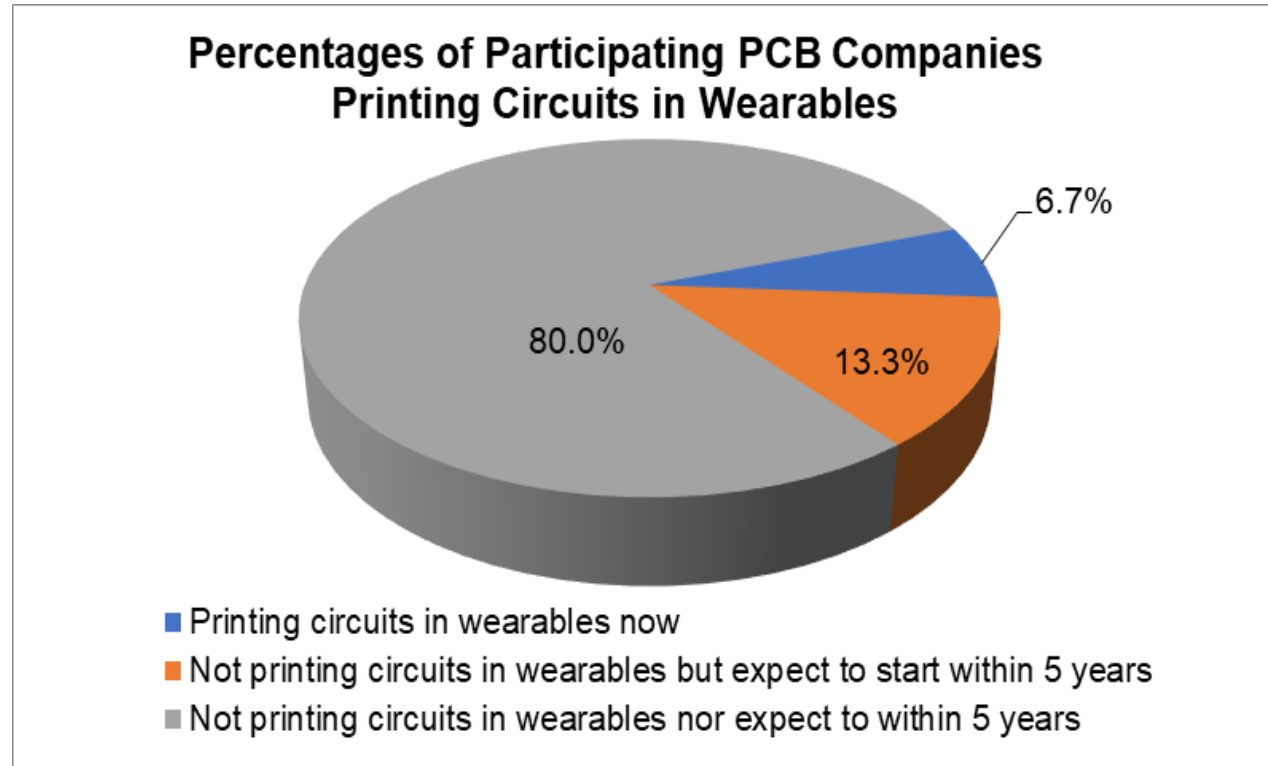


Use of Printed Electronics (PE) or Hybrid PE by PCB Companies (Percent of Participants) - Asia



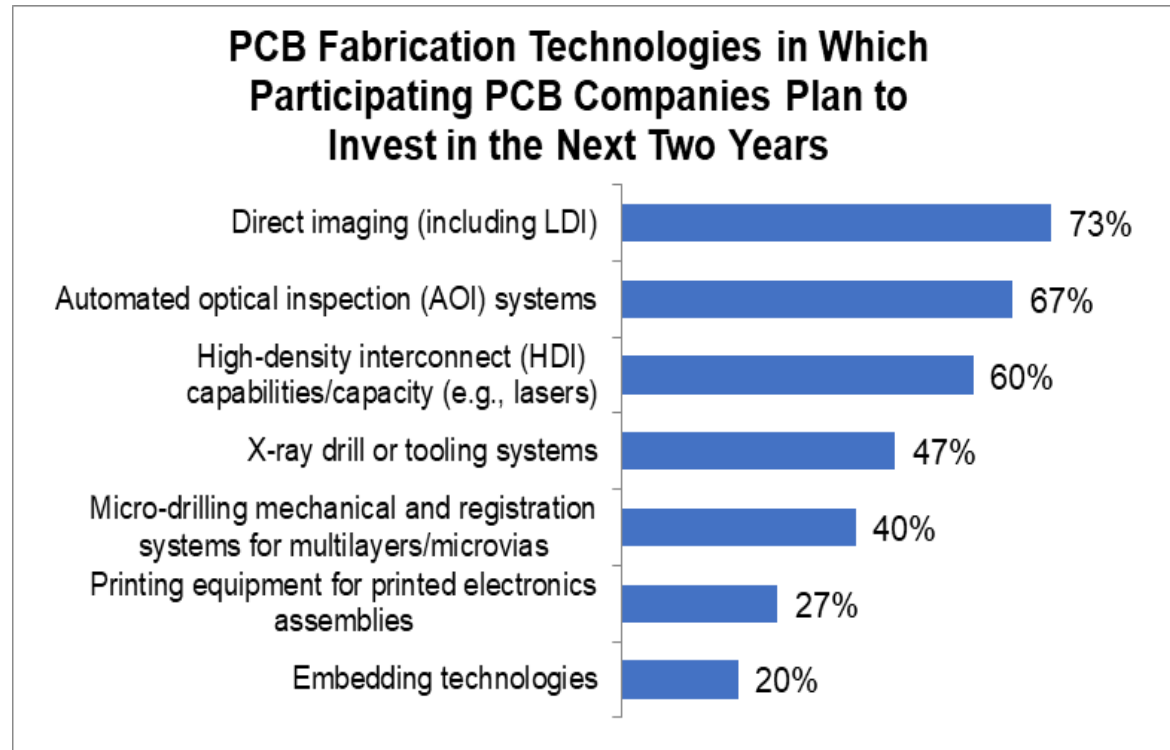
- ❖ Almost one-quarter of the PCB fabricators in Asia reported that they are using printed electronics in production today.
- ❖ In both regions a substantial percentage of fabricators expect to begin incorporating PE into their production in the next 5 years.
- ❖ The participating PCB fabricators expect all of the growth to be in the use of hybrid (versus stand-alone) PE.

E-Textiles



- ❖ A small proportion of the PCB fabricators surveyed are printing circuits in wearables today and they are all in Asia.
- ❖ More expect to start in the next 5 years, but most do not anticipate printing circuits in wearables in the near future.

Capital Investment by PCB Fabricators



- ❖ Most of the PCB fabricators surveyed plan to invest in equipment for direct imaging, AOI and high-density interconnect production within the next 2 years.
- ❖ Investment in PE and embedding is planned by several of the fabricators.

Thank you.

Questions?



PCB Technology Trends 2018 is available in the IPC Online Store

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