2019 Embedded Markets Study
Integrating IoT and Advanced Technology Designs,
Application Development & Processing Environments
March 2019
Preliminary Comments

• **Results:** Data from this study is highly projectable at 95% confidence with +/-3.15% confidence interval. Other consistencies with data from previous versions of this study also support a high level of confidence that the data reflects accurately the EETimes and Embedded.com audience’s usage of advance technologies, software and hardware development tools, chips, operating systems, FPGA vendors, and the entire ecosystem of their embedded development work environment and projects with which they are engaged.

• **Historical:** The EETimes/Embedded.com Embedded Markets Study was last conducted in 2017. This report often compares results for 2019 to 2017 and in some cases to 2015 and earlier. This study was first fielded over 20 years ago and has seen vast changes in technology evolution over that period of time.

• **Consistently High Confidence:** Remarkable consistency over the years has monitored both fast and slow moving market changes. A few surprises are shown this year as well, but overall trends are largely confirmed.

• **New Technologies and IoT:** Emerging markets and technologies are also tracked in this study. New data regarding IoT and advanced technologies (IIoT, embedded vision, embedded speech, VR, AR, machine learning, AI and other cognitive capabilities) are all included.
Purpose and Methodology

- **Purpose:** To profile the findings of the 2019 Embedded Markets Study comprehensive survey of the embedded systems markets worldwide. Findings include technology used, all aspects of the embedded development process, IoT, emerging technologies, tools used, work environment, applications developed for, methods/processes, operating systems used, reasons for using chips and technology, and brands and specific chips being considered by embedded developers.

- **Methodology:** A web-based online survey instrument based on the 2017 survey was developed and implemented by independent research company Wilson Research Group. It was fielded on January 29, 2019, and closed March 7, 2019.

- **Sample:** E-mail invitations were sent to subscribers to EETimes and Embedded.com and AspenCore related brands with reminder invitations sent at 5-7 day intervals. Each invitation included a link to the survey and incentives to participate.

- **Returns:** This data is based on 958 valid respondents for an overall confidence of 95% +/-3.15%. Confidence levels vary by question. Confidences for questions with:
  - 958 respondents for 2019 = 95% +/- 3.15%
  - 1,234 respondents for 2017 = 95% +/- 2.8%
  - 600 respondents = 95% +/- 4.0% = high confidence, fairly tight margin of error
  - 400 respondents = 95% +/- 5.0% = high confidence, standard margin of error
  - 300 respondents = 95% +/- 5.5% = high confidence, with slightly wider margin of error
  - 200 respondents = 95% +/- 6.7% = high confidence, with still wider margin of error
In which region of the world do you reside?

- **The Americas**: 58% (2019), 61% (2017)
- **EMEA**: 21% (2019), 27% (2017)
- **APAC**: 21% (2019), 13% (2017)

Bar chart showing regional distribution with percentages for 2019 and 2017.
How many employees does your company have at all locations?

- **Under 100**: 48% (2019) vs. 47% (2017)
- **100-499**: 13% (2019) vs. 14% (2017)
- **500-999**: 7% (2019) vs. 7% (2017)
- **1,000-4,999**: 10% (2019) vs. 10% (2017)
- **5,000-9,999**: 5% (2019) vs. 6% (2017)
- **10,000-19,999**: 6% (2019) vs. 3% (2017)
- **20,000 or more**: 9% (2019) vs. 11% (2017)
- **Don't know**: 2% (2019) vs. 3% (2017)

**Average Number of Employees:**
- **2019**: 3,467
- **2017**: 3,452
- **2015**: 3,644
- **2014**: 3,842
Job Functions

- Hardware/software integration: 59%
- Debugging firmware/software: 52%
- Architecture selection/specification: 52%
- Writing firmware/software for embedded systems: 51%
- Debugging hardware: 44%
- Firmware/software design or analysis: 43%
- Project management: 41%
- Prototype testing: 41%
- Firmware/software testing: 35%
- Device programming: 35%
- Designing hardware for embedded systems: 34%
- System design: 31%
- Hardware/software co-design: 26%
- Board layout/design: 25%
- Hardware/software co-verification: 16%
- Connected device design: 10%
- SoC (system-on-chip) design: 7%
- Other (please specify): 5%

Average number of years out of school:
- 2019 = 26.3 years
- 2017 = 24.9 years
- 2015 = 20.0 years
- 2014 = 21.8 years
- 2013 = 19.7 years

World | Americas | EMEA | APAC
--- | --- | --- | ---
Avg # of years out of school | 26.3 | 28.3 | 23.2 | 21.9
For what types of applications are your embedded projects developed?

- **Industrial control/automation**
  - 2019: 32%
  - 2017: 25%
  - 2015: 19%

- **Consumer electronics**
  - 2019: 34%
  - 2017: 29%
  - 2015: 24%

- **Internet of Things (IoT)**
  - 2019: 21%
  - 2017: 25%
  - 2015: 24%

- **Communications/netwrkg/wireless**
  - 2019: 19%
  - 2017: 20%
  - 2015: 21%

- **Automotive**
  - 2019: 16%
  - 2017: 17%
  - 2015: 15%

- **Medical**
  - 2019: 14%
  - 2017: 16%
  - 2015: 15%

- **Electronic instruments**
  - 2019: 19%
  - 2017: 17%
  - 2015: 17%

- **Military/Aerospace**
  - 2019: 14%
  - 2017: 15%
  - 2015: 15%

- **Audio**
  - 2019: 10%
  - 2017: 10%
  - 2015: 15%

- **Computers and peripherals**
  - 2019: 9%
  - 2017: 10%
  - 2015: 15%

- **Power generation and utilities**
  - 2019: 8%
  - 2017: 9%
  - 2015: 10%

- **Video/ imaging**
  - 2019: 7%
  - 2017: 8%
  - 2015: 8%

- **Transportation**
  - 2019: 8%
  - 2017: 8%
  - 2015: 8%

- **Government /municipal**
  - 2019: 7%
  - 2017: 8%
  - 2015: 6%

- **Security**
  - 2019: 8%
  - 2017: 8%
  - 2015: 8%

**Note:** In 2019, EMEA exceeded all other regions for industrial controls (41%). APAC was high for consumer electronics (40%) and form...
How important will IoT development be to you and your organization in the next 12 months?

- **Not sure/Don't know**: 11%
- **Not at all important**: 16%
- **Not very important**: 23%
- **Critical important**: 7%
- **Very important**: 16%
- **Important**: 27%

Significantly, for APAC "Critically important" to "Important" is 64%
If you are developing Internet of Things (IoT) applications, please indicate the type of application.

- **Sensor-driven**: 40% (2019), 39% (2017)
- **Industrial**: 35% (2019), 42% (2017)
- **IP connected cloud/router**: 28% (2019), 29% (2017)
- **Smartphone/mobile connected**: 20% (2019), 26% (2017)
- **Smart buildings**: 19% (2019), 19% (2017)
- **Control loop***: 17% (2019)
- **Medical**: 15% (2019), 17% (2017)
- **Edge-computing service (security, AI)***: 15% (2019)
- **Non-IP connected hub/gateway**: 7% (2019), 12% (2017)
- **Connected vehicles**: 11% (2019), 13% (2017)
- **Wearable**: 11% (2019), 14% (2017)
- **Other**: 7% (2019), 7% (2017)

* Added in 2019.
If you are creating Internet of Things (IoT) devices, please indicate the types of devices you are currently designing and considering for your next design.

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Devices currently designing for (N=296)</th>
<th>Devices considering for next design (N=265)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IoT edge device/system (on the edge of the Internet)</td>
<td>55%</td>
<td>47%</td>
</tr>
<tr>
<td>IoT bridge device/system</td>
<td>28%</td>
<td>28%</td>
</tr>
<tr>
<td>Wearable/mobile device/system</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>IoT infrastructure device/system</td>
<td>26%</td>
<td>28%</td>
</tr>
<tr>
<td>IoT cloud-based application/service or full edge to cloud systems</td>
<td>22%</td>
<td>33%</td>
</tr>
<tr>
<td>Other</td>
<td>7%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Will have one or more projects devoted to IoT.

- 65.7% of all projects will be primarily devoted to IoT.
- 34.3% of all projects will have one or more projects devoted to IoT.
- No projects devoted to IoT.

2019 (N = 424)
Considering all applications of which you are aware, what do you regard as the most interesting use of the IoT? (Selected write-in responses from 2019 & 2017).

- Automatic traffic control.
- AR/VR -- Augmented Reality/Virtual Reality.
- Connected automated houses/buildings.
- Connected/autonomous vehicles.
- Detecting location: providing original content by screen, audio, phone.
- Distributed sensing for diagnostics and control. Think of sensors that detect bearing, failures in rotating machinery, bridges, roadways, factory lines etc.
- Environment monitoring/ global electrical energy consumption reduction.
- Intelligent industrial machines, predictive maintenance of industrial components.
- Remote medical information/diagnostic integration, medical devices.
- Real-time sensing (road conditions, power grid data, total-plant monitoring).
- Earthquake/seismic monitoring signaling building evacuations in time to save lives.
- Drones; remote control and monitoring.
- Security within IOT - the technology is totally insecure.
- Smart cities, smart factories, precision agriculture, pest management in farming.
- Brain waves to control wheelchair movement. Opportunities endless and scary.
- Wireless monitor for underground water.
2015: Machine Learning and IoT at peak of hype! AR is in disillusionment, VR moving towards productive implementations!
2018: Machine Learning (Deep Neural Nets) and IoT still at Peak Hype! AR has moved along only slightly, and VR is out of hype stage and into productivity.
Are you using any of these **advanced technologies** in your embedded systems?

<table>
<thead>
<tr>
<th>Technology</th>
<th>Currently Using 2019 (N = 194)</th>
<th>Considering Using 2019 (N = 314)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded vision</td>
<td>43%</td>
<td>37%</td>
</tr>
<tr>
<td>Machine learning model-based</td>
<td>32%</td>
<td>55%</td>
</tr>
<tr>
<td>capabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Embedded speech</td>
<td>28%</td>
<td>27%</td>
</tr>
<tr>
<td>Other AI/cognitive capabilities</td>
<td>21%</td>
<td>38%</td>
</tr>
<tr>
<td>Virtual Reality (VR) capabilities</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>Augmented Reality (AR) capabilities</td>
<td>10%</td>
<td>19%</td>
</tr>
</tbody>
</table>

68% of EMEA users are considering using Machine Learning
What security measures are you incorporating into your current design?

- Encryption: 45%
- Authentication: 41%
- Secure boot: 27%
- Secure OTA firmware update: 22%
- Tamper intrusion protection: 14%
- Secure provisioning for keys/certs: 12%
- Secure commissioning: 6%
- Other: 3%
- Considering options: 17%
- None: 16%
- Don't know: 5%

Have taken one or more security measures:
- 70% in 2019
- 66% in 2017
- 61% in 2015

EMEA uses **Encryption** significantly more than other regions (49%).
What hardware support measures are you implementing into your current design?

- MCU security features: 31%
- Software-only security: 26%
- Hardware-based security (Sec Elements, TPM): 20%
- Secure storage: 12%
- Dedicated security IC: 12%
- Hardware security module (for supply chain): 8%
- Mitigation for side-channel attacks: 5%
- Other: 2%
- None: 20%
- Don't know: 9%

Have implemented one or more hardware support measures: **71%**

2019 (N = 626)
Overall Background

- **Focus** – IoT, AI, AV, AR and other advanced technologies focus.

- **World Regions** – The Americas (58%), EMEA at (21%), and APAC at (21%).

- **Company Size** – Avg of 3,467 employees. Americas (4,091), EMEA (1,858), APAC (3,034).

- **Number of Years Out of School**: Average years out of school for the 2019 is 26.3.

- **Job functions** – Hardware/software integration (59%), debugging (52%), architecture design (52%), writing firmware/software (51%) were top four job functions.

- **Applications Developed** – Top three apps were *Industrial controls* (32%), *consumer electronics* (29%) and *Internet of Things* (25%) remained even with 2017.

- **IoT Usage/Advanced Technologies** – Half (50%) of users feel IoT will be *important to critically important* in 2019 (same as 2017), but among APAC users it is 64%. IoT apps include sensor driven (40%), industrial (35%), IP connected cloud (28%), smart phone/mobile (20%) and smart buildings (19%).

- **Advanced technology** used most was *embedded vision* (43%). Machine learning (55%) has greatest potential. 55% are creating IoT edge of the internet devices. 66% will have one or more projects devoted to IoT.

- **Security** – 70% of respondents are taking software security measures: 45% *encryption*, 41% *authentication*. 71% used hardware support measures, which included MCU security at 31%.
Current Embedded Design Environment
My current embedded project is...

New to the world; a new project from scratch

- 2019 (N = 944): 44%
- 2017 (N = 1,223): 44%
- 2015 (N = 1,807): 44%

An upgrade or improvement to an earlier or existing project

- 2019 (N = 944): 56%
- 2017 (N = 1,223): 56%
- 2015 (N = 1,807): 56%

In 2019, APAC ratio of “New to the World” vs “Upgrade” was 40%/60%.
What does the upgrade or improvement include?

- **New or different software features**
  - 2019: 50%
  - 2017: 38%
  - 2015: 13%

- **New or different processor**
  - 2019: 46%
  - 2017: 37%
  - 2015: 13%

- **New or different connectivity capabilities**
  - 2019: 24%
  - 2017: 17%
  - 2015: 12%

- **Mandatory changes/discontinued hwrd/swrd**
  - 2019: 19%
  - 2017: 17%
  - 2015: 15%

- **New or different analog components**
  - 2019: 16%
  - 2017: 14%
  - 2015: 12%

- **New or different system logic**
  - 2019: 15%
  - 2017: 15%
  - 2015: 10%

- **New or different peripherals**
  - 2019: 16%
  - 2017: 14%
  - 2015: 12%

- **New or different operating system**
  - 2019: 13%
  - 2017: 10%
  - 2015: 10%

*Base = Those whose current project is an upgrade/improvement*
Which of the following capabilities are included in your current embedded project?

- Real-time capability: 54% (2019) vs. 59% (2017)
- Digital signal processing: 51% (2019) vs. 56% (2017)
- Networking capability: 49% (2019) vs. 54% (2017)
- Analog signal processing: 46% (2019) vs. 50% (2017)
- Wireless capability: 42% (2019) vs. 40% (2017)
- Battery-powered: 34% (2019) vs. 34% (2017)
- Rugged design: 31% (2019) vs. 34% (2017)
- GUI: 26% (2019) vs. 36% (2017)
- AI (machine learning)*: 15% (2019)
- GPU*: 9% (2019)

*AI and GPU were added in 2019.
If wireless, what wireless interfaces does your current embedded project include?

- **Wi-Fi**: 65% (2019, N = 344) vs. 65% (2017, N = 379)
- **Bluetooth Low Energy (BLE)**: 45% vs. 31%
- **Bluetooth**: 35% vs. 25%
- **Wideband Cellular (LTE, 3G, 2G)**: 19% vs. 25%
- **NFC**: 14% vs. 10%
- **Narrowband Cellular (NB-IoT, LTE Cat-M, EC-GSM)**: 13% vs. 10%
- **LoRA**: 11% vs. 7%
- **IEEE802.15.4**: 10% vs. 14%
- **Sub-GHz**: 10% vs. 10%
- **IEEE802.15.4g**: 6% vs. 5%
- **Z-Wave**: 3% vs. 3%
- **SigFox**: 2% vs. 3%
- **RPMA**: 1% vs. 1%
- **Other**: 9% vs. 13%

*Added in 2019.*
If wireless, what wireless protocols/stacks does your current embedded project include?

- **BLE mesh**: 30% (2019), 29% (2017)
- **Wireless I/O Link**: 29% (2019), 24% (2017)
- **Zigbee**: 21% (2019), 35% (2017)
- **6LoWPAN**: 15% (2019), 15% (2017)
- **Mbed**: 9% (2019), 12% (2017)
- **Thread**: 10% (2019), 11% (2017)
- **ISA 100**: 2% (2019)
- **Wireless HART**: 6% (2019), 10% (2017)
- **Other**: 29% (2019), 45% (2017)

*Top mentions:
- Proprietary
- Custom
- LoRaWAN
- 802.11

*Added in 2019.*
How many people are on your embedded project team?

16.1 engineers per team is significantly higher than 2017 and 2015 due to increase in Software Engineers and Other team engineers.

Team size for Americas is 15.1 engineers/ team.
Team size for EMEA is 14.1 engineers/ team.
Team size for APAC is 19.6 engineers/ team.
Teams also work with an average of 2.7 outside vendors on a typical project.
What is your development team’s ratio of total resources (including time/dollars/manpower) spent on software vs. hardware for your embedded projects?

In 2019, respondents averaged working on 2.1 projects at the same time.
In 2017, respondents averaged working on 2.1 projects at the same time.
In 2015, respondents averaged working on 2.1 projects at the same time.
In 2014, respondents averaged working on 2.0 projects at the same time.
Do you primarily design or subcontract the design of custom circuit boards, or do you purchase off-the-shelf boards?

2019 (N = 752)
- Primarily design or subcontract our own boards: 77%
- Primarily purchase OTS boards: 23%

2017 (N = 923)
- Primarily design or subcontract our own boards: 81%
- Primarily purchase OTS boards: 19%
Did you start your current embedded design with a development board?

<table>
<thead>
<tr>
<th>Development Board Started With</th>
<th>N=281</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>STMicroelectronics</td>
<td>43</td>
<td>15.3%</td>
</tr>
<tr>
<td>TI</td>
<td>30</td>
<td>10.7%</td>
</tr>
<tr>
<td>NXP</td>
<td>20</td>
<td>7.1%</td>
</tr>
<tr>
<td>Raspberry Pi</td>
<td>19</td>
<td>6.8%</td>
</tr>
<tr>
<td>Microchip</td>
<td>14</td>
<td>5.0%</td>
</tr>
<tr>
<td>Arduino</td>
<td>13</td>
<td>4.6%</td>
</tr>
<tr>
<td>Xilinx</td>
<td>13</td>
<td>4.6%</td>
</tr>
<tr>
<td>Atmel</td>
<td>11</td>
<td>3.9%</td>
</tr>
<tr>
<td>Espressif ESP-32</td>
<td>7</td>
<td>2.5%</td>
</tr>
<tr>
<td>Renesas</td>
<td>7</td>
<td>2.5%</td>
</tr>
<tr>
<td>Silicon Labs</td>
<td>6</td>
<td>2.1%</td>
</tr>
<tr>
<td>Nordic</td>
<td>5</td>
<td>1.8%</td>
</tr>
<tr>
<td>Digilent</td>
<td>4</td>
<td>1.4%</td>
</tr>
<tr>
<td>Nucleo Board</td>
<td>4</td>
<td>1.4%</td>
</tr>
<tr>
<td>ZedBoard</td>
<td>4</td>
<td>1.4%</td>
</tr>
<tr>
<td>Analog Devices</td>
<td>3</td>
<td>1.1%</td>
</tr>
<tr>
<td>Beaglebone Black</td>
<td>3</td>
<td>1.1%</td>
</tr>
<tr>
<td>Cypress</td>
<td>3</td>
<td>1.1%</td>
</tr>
<tr>
<td>AdaFruit 'Feather' Cortex-M4</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>ARM</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>Atmega</td>
<td>2</td>
<td>0.7%</td>
</tr>
<tr>
<td>Avnet Picozed</td>
<td>2</td>
<td>0.7%</td>
</tr>
</tbody>
</table>
Which form factor boards are you currently using, and which are you considering using?

- **2019 Currently Using (N = 697)**
  - Custom design: 26%
  - Proprietary: 18%
  - Arduino: 17%
  - Raspberry Pi: 12%
  - STM32 Nucleo: 9%
  - 3.5": 8%
  - PCI Express: 8%
  - LaunchPad: 6%
  - Beagle Board/Bone: 6%
  - 5.25": 5%
  - PCI: 4%
  - CompactPCI: 4%

- **2019 Considering Using (N = 553)**
  - Custom design: 27%
  - Proprietary: 17%
  - Arduino: 17%
  - Raspberry Pi: 16%
  - STM32 Nucleo: 10%
  - 3.5": 6%
  - PCI Express: 7%
  - LaunchPad: 6%
  - Beagle Board/Bone: 7%
  - 5.25": 4%
  - PCI: 3%
  - CompactPCI: 4%

*Note: Answers under 4% are excluded.*
Thinking now about the last embedded project you completed (no longer in development), how many months did that project take to finish?

- **1 – 6 months**: 31% (2019), 34% (2017), 36% (2015), 36% (2014), 34% (2013)
- **7 – 12 months**: 31% (2019), 34% (2017), 33% (2015), 33% (2014), 35% (2013)
- **13 – 18 months**: 11% (2019), 12% (2017), 16% (2015), 10% (2014), 15% (2013)
- **19 – 24 months**: 6% (2019), 9% (2017), 10% (2015), 9% (2014), 8% (2013)
- **25 months or more**: 6% (2019), 7% (2017), 6% (2015), 6% (2014), 7% (2013)

**Americas** averaged 12.7 months  
**EMEA** averaged 12.6 months  
**APAC** averaged 10.1 months
In 2019, 39% of all projects finished “ahead of” or “on” schedule, and 61% finished “late or cancelled”.

In 2017, 41% of all projects finished “ahead of” or “on” schedule, and 59% finished “late or cancelled”.

In 2015, 38% of all projects finished “ahead of” or “on” schedule, and 62% finished “late or cancelled”.

Was that project completed . . .
My *current* embedded project is programmed mostly in:

- **C**: 56% (2019), 56% (2017)
- **C++**: 23% (2019), 22% (2017)
- **Python**: 6% (2019), 3% (2017)
- **Assembly language**: 4% (2019), 4% (2017)
- **Java**: 2% (2019), 2% (2017)
- **MATLAB**: 1% (2019), 2% (2017)
- **LabVIEW**: 2% (2019), 2% (2017)
- **JavaScript**: 1% (2019), 1% (2017)
- **C#**: 1% (2019), 2% (2017)

© 2019 Copyright by AspenCore. All rights reserved.
My *next* embedded project will likely be programmed mostly in:

- **C**: 49% (2019) vs. 52% (2017)
- **C++**: 26% (2019) vs. 24% (2017)
- **Python**: 8% (2019) vs. 5% (2017)
- **C#**: 3% (2019) vs. 3% (2017)
- **Assembly language**: 3% (2019) vs. 2% (2017)
- **MATLAB**: 2% (2019) vs. 2% (2017)
- **LabVIEW**: 2% (2019) vs. 2% (2017)
- **Java**: 2% (2019) vs. 2% (2017)
- **UML or other modeling language**: 1% (2019) vs. 1% (2017)
Does your current project reuse code from a previous embedded project?

Note 1. Multiple choice for “Yes” answers (a respondents can select more than one type of reused code), therefore will not add to 88%.

Note 2. In 2019, 77% of respondents also reused hardware or hardware IP, up 1% from 2017.

In 2019, 88% reused code.
In 2017, 87% reused code.
In 2015, 86% reused code.
In 2014, 86% reused code.
In 2013, 86% reused code.
Embedded Design Environment

- **New/Upgrade Ratio** – 44% new/56% upgrades. APAC ratio is 40%/60%.
  
  Upgrades include new software features (46%), processors (37%), connectivity (22%).

- **Design Capabilities** – Real time (54%), DSP (51%), Networking (49%).

- **Team Size** – 16.1 engineers is up from 14.8. APAC has 19.6 engineers per team.

- **Outside vendors** – Work with an average of 2.7 outside vendors.

- **Resources Used On** – Software (60%), hardware (40%). No change in 5 years.

- **Number of Projects Worked On at the Same Time** – Average of 2.1 projects.

- **Build or Purchase Boards** – 77% build their own boards, 23% purchase OTS.

- **Project Starts with Board** – 46% is up 2% from 2017. STMico, TI, NXP mostly.

- **Form Factor Boards Used** – Custom design (26%), proprietary (18%) top two.

- **Months to Complete Project** – 12.2 mos. on average. APAC was 10.1 mos.

- **On or ahead of schedule** – 39% in 2019 is two ticks down from 2017.

- **Languages** – C usage at 56%, C++ 23%. Python is starting to grow.

- **Code/HW IP Reuse** – 88% code reuse; 77% hardware or hardware IP reuse.
Embedded Design Process
Which of the following challenges are your own or your embedded design team's greatest concerns regarding your current embedded systems development?

<table>
<thead>
<tr>
<th>Challenge</th>
<th>2019 (N = 694)</th>
<th>2017 (N = 887)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meeting application performance requirements</td>
<td>15%</td>
<td>16%</td>
</tr>
<tr>
<td>Meeting schedules</td>
<td>22%</td>
<td>23%</td>
</tr>
<tr>
<td>The debugging process</td>
<td>22%</td>
<td>23%</td>
</tr>
<tr>
<td>Ensuring data security</td>
<td>13%</td>
<td>12%</td>
</tr>
<tr>
<td>Testing/systems integration</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Maintaining legacy code</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Increased lines of code &amp; software complexity</td>
<td>11%</td>
<td>13%</td>
</tr>
<tr>
<td>Ensuring code/IP security</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Power management/energy efficiency</td>
<td>9%</td>
<td>10%</td>
</tr>
<tr>
<td>Keeping pace with embedded systems technology</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Software compatibility when porting to new devices</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Sticking to our cost budget</td>
<td>7%</td>
<td>7%</td>
</tr>
<tr>
<td>Meeting safety &amp; development process standards</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Providing network connectivity</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Managing remote design team/multiple locations</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>
What percentage of your design time is spent on each of the following stages?

- Developing system specs: 13% (2019), 14% (2017), 14% (2015)
- Detailed design stage: 31% (2019), 32% (2017), 29% (2015)
- Simulation stage: 6% (2019), 6% (2017), 8% (2015)
- Transitioning to production: 6% (2019), 7% (2017), 6% (2015)
How do you typically find and evaluate partners to work with?

Number of outside partners worked with on average:
- 2.7 vendors in 2019
- 2.7 vendors in 2017
- 3.2 vendors in 2015
If you could improve one thing about your embedded design activities, what would it be?

Top three:
- Engineering team skill level
- Debugging tools
- Schedule

Regional breakout:
- “Team skill level” is more important to EMEA and APAC.
- “Debugging tools” is less important to EMEA.
- “Schedule” is less important to APAC.

<table>
<thead>
<tr>
<th>Top Three Improvements</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team's skill level</td>
<td>20.3</td>
<td>17.3</td>
<td>23.5</td>
<td>26.2</td>
</tr>
<tr>
<td>Debugging tools</td>
<td>20.1</td>
<td>21.0</td>
<td>17.6</td>
<td>20.0</td>
</tr>
<tr>
<td>The schedule</td>
<td>11.9</td>
<td>13.3</td>
<td>12.5</td>
<td>6.9</td>
</tr>
</tbody>
</table>
In general, what sources of information do you consult to research your embedded design decisions?

Top 15 Sources

- Websites of vendors/mfrs: 83% (2019), 85% (2017)
- Search engine: 54% (2019), 59% (2017)
- Technical whitepapers: 51% (2019), 50% (2017)
- Colleagues: 46% (2019), 46% (2017)
- Technical standards: 42% (2019), 42% (2017)
- Websites of distributors: 37% (2019), 37% (2017)
- Vendor tech support forums: 37% (2019), 37% (2017)
- Technical communities (Sourceforge, ...): 36% (2019), 38% (2017)
- Print publications: 30% (2019), 34% (2017)
- Webinars/webcasts: 29% (2019), 25% (2017)
- Conferences/trade shows: 24% (2019), 23% (2017)
- Video (YouTube, etc.): 19% (2019), 15% (2017)
- Blogs: 17% (2019), 18% (2017)
- Catalogs/brochures: 17% (2019), 18% (2017)
### What are your favorite websites related to your professional work? (Write-in responses only)

<table>
<thead>
<tr>
<th>Favorite Website (Write-in)</th>
<th>N = 350</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE Times</td>
<td>53</td>
<td>10.9%</td>
</tr>
<tr>
<td>Google</td>
<td>41</td>
<td>8.4%</td>
</tr>
<tr>
<td>Embedded.com</td>
<td>37</td>
<td>7.6%</td>
</tr>
<tr>
<td>Stack Overflow</td>
<td>26</td>
<td>5.3%</td>
</tr>
<tr>
<td>Digikey</td>
<td>23</td>
<td>4.7%</td>
</tr>
<tr>
<td>EDN</td>
<td>20</td>
<td>4.1%</td>
</tr>
<tr>
<td>IEEE</td>
<td>19</td>
<td>3.9%</td>
</tr>
<tr>
<td>TI</td>
<td>19</td>
<td>3.9%</td>
</tr>
<tr>
<td>Analog Devices</td>
<td>11</td>
<td>2.3%</td>
</tr>
<tr>
<td>Github.com</td>
<td>11</td>
<td>2.3%</td>
</tr>
<tr>
<td>LinkedIn</td>
<td>11</td>
<td>2.3%</td>
</tr>
<tr>
<td>Stack Exchange</td>
<td>11</td>
<td>2.3%</td>
</tr>
<tr>
<td>Microchip</td>
<td>9</td>
<td>1.8%</td>
</tr>
<tr>
<td>Wikipedia</td>
<td>9</td>
<td>1.8%</td>
</tr>
<tr>
<td>Electronicdesign.com</td>
<td>8</td>
<td>1.6%</td>
</tr>
<tr>
<td>Hackaday</td>
<td>6</td>
<td>1.2%</td>
</tr>
<tr>
<td>Microsoft</td>
<td>6</td>
<td>1.2%</td>
</tr>
<tr>
<td>Mouser</td>
<td>5</td>
<td>1.0%</td>
</tr>
<tr>
<td>Xilinx</td>
<td>5</td>
<td>1.0%</td>
</tr>
<tr>
<td>Youtube.com</td>
<td>5</td>
<td>1.0%</td>
</tr>
<tr>
<td>Texas Instruments</td>
<td>4</td>
<td>0.8%</td>
</tr>
<tr>
<td>Embedded Systems Design</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td>NXP</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td>Sourceforge</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td>ST.com</td>
<td>3</td>
<td>0.6%</td>
</tr>
<tr>
<td>ADI/LTCC</td>
<td>2</td>
<td>0.4%</td>
</tr>
<tr>
<td>Arduino</td>
<td>2</td>
<td>0.4%</td>
</tr>
<tr>
<td>Avrfreaks.net</td>
<td>2</td>
<td>0.4%</td>
</tr>
</tbody>
</table>
Thinking about the next year, what areas will be your greatest technology challenges?

- Integrating new technology or tools: 20%
- Managing code size/complexity: 16%
- Security concerns: 15%
- Software tools: 14%
- Dealing with low power processors: 13%
- Improving the debugging process: 12%
- Dealing with wireless: 11%
- Functional safety: 8%
- OS/RTOS: 8%
- Hardware tools: 8%
- Programmable logic: 7%
- SoCs/ASICs/ASSPs: 6%
- Connecting to the cloud: 5%
- Integrating external IPs into designs: 4%
- Buses/interconnects: 3%
- Memories and standard cells: 2%
- IDE: 2%

2019 (N = 663)
Which of the following are your favorite/most important software/hardware tools?

(Top 21 shown)

- Oscilloscope: 43% (2019), 50% (2017)
- Debugger: 41% (2019), 46% (2017)
- Compiler/assembler: 35% (2019), 42% (2017)
- Logic analyzer: 21% (2019), 22% (2017)
- JTAG/BDM: 17% (2019), 19% (2017)
- Software libraries: 16% (2019), 14% (2017)
- ICE: 12% (2019), 12% (2017)
- Linux tools: 10% (2019), 14% (2017)
- Static analysis tools: 9% (2019), 7% (2017)
- Starter, evaluation kits/boards: 8% (2019), 6% (2017)
- Hardware emulators: 8% (2019), 5% (2017)
- Software testing tools: 7% (2019), 6% (2017)
- Software drivers: 7% (2019), 5% (2017)
- Automatic code generation: 9% (2019), 6% (2017)
- Configuration management tools: 9% (2019), 6% (2017)
- Graphical Design tools: 7% (2019), 6% (2017)
- Network debuggers: 7% (2019), 4% (2017)
- Simulation modeling tools: 6% (2019), 4% (2017)
- FPGA-based prototypes: 6% (2019), 4% (2017)
- Trace: 5% (2019), 4% (2017)
Which of the following conferences have you attended in the last two years, and which do you plan to attend in the next year?

<table>
<thead>
<tr>
<th>Conferences</th>
<th>Have Attended</th>
<th>Plan to Attend</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training/seminars of distributors</td>
<td>40.2</td>
<td>33.2</td>
<td>-7.0</td>
</tr>
<tr>
<td>Embedded Systems Conference (USA)</td>
<td>17.5</td>
<td>26.4</td>
<td>+8.9</td>
</tr>
<tr>
<td>Vendor technical forums/developer conferences</td>
<td>16.8</td>
<td>12.5</td>
<td>-4.3</td>
</tr>
<tr>
<td>Embedded World (Nuremberg)</td>
<td>15.7</td>
<td>19.3</td>
<td>+3.6</td>
</tr>
<tr>
<td>CES (Las Vegas)</td>
<td>12.6</td>
<td>16.8</td>
<td>+4.2</td>
</tr>
<tr>
<td>Electronica</td>
<td>11.9</td>
<td>13.6</td>
<td>+1.7</td>
</tr>
<tr>
<td>DesignCon</td>
<td>11.2</td>
<td>15.4</td>
<td>+4.2</td>
</tr>
<tr>
<td>Sensors Expo</td>
<td>9.8</td>
<td>14.6</td>
<td>+4.9</td>
</tr>
<tr>
<td>DAC</td>
<td>7.3</td>
<td>7.1</td>
<td>-0.2</td>
</tr>
<tr>
<td>IEEE International Conference on Embedded and Real-Time Computing Systems and Applications</td>
<td>7.0</td>
<td>10.4</td>
<td>+3.4</td>
</tr>
<tr>
<td>Embedded Linux Conference (ELC)</td>
<td>6.3</td>
<td>7.1</td>
<td>+0.8</td>
</tr>
<tr>
<td>CeBIT</td>
<td>5.6</td>
<td>6.8</td>
<td>+1.2</td>
</tr>
<tr>
<td>Embedded Systems Conference (India)</td>
<td>5.2</td>
<td>7.5</td>
<td>+2.3</td>
</tr>
<tr>
<td>Embedded Systems Expo (Japan)</td>
<td>4.2</td>
<td>2.5</td>
<td>-1.7</td>
</tr>
<tr>
<td>Android Builders Summit</td>
<td>3.5</td>
<td>3.2</td>
<td>-0.3</td>
</tr>
<tr>
<td>Mobile World Congress</td>
<td>3.1</td>
<td>5.7</td>
<td>+2.6</td>
</tr>
<tr>
<td>SAE Convergence</td>
<td>3.1</td>
<td>3.9</td>
<td>+0.8</td>
</tr>
<tr>
<td>IIC (China)</td>
<td>2.8</td>
<td>3.9</td>
<td>+1.1</td>
</tr>
<tr>
<td>Embedded Systems Conference (Brazil)</td>
<td>1.0</td>
<td>2.5</td>
<td>+1.5</td>
</tr>
<tr>
<td>Other</td>
<td>7.3</td>
<td>4.6</td>
<td>-2.7</td>
</tr>
<tr>
<td><strong>2019</strong></td>
<td><strong>N = 286</strong></td>
<td><strong>N = 280</strong></td>
<td></td>
</tr>
</tbody>
</table>
What are the most effective ways that you systematically or formally maintain, educate, and advance your professional skills?

<table>
<thead>
<tr>
<th>Top four</th>
<th>2019 (N = 590)</th>
<th>2017 (N = 799)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Online training/webinars provided by vendors</td>
<td>43%</td>
<td>40%</td>
</tr>
<tr>
<td>Technical white papers from vendors</td>
<td>38%</td>
<td>37%</td>
</tr>
<tr>
<td>Professional/technical journals</td>
<td>34%</td>
<td>38%</td>
</tr>
<tr>
<td>Online training/webinars by media orgs (EE Times)</td>
<td>32%</td>
<td>31%</td>
</tr>
<tr>
<td>Professional devpmnt courses by private cos</td>
<td>18%</td>
<td>19%</td>
</tr>
<tr>
<td>Online training/webinars provided by distributors</td>
<td>19%</td>
<td>18%</td>
</tr>
<tr>
<td>Online training/webinars by profnl assoc (like IEEE)</td>
<td>17%</td>
<td>16%</td>
</tr>
<tr>
<td>On-site seminars given by vendors</td>
<td>15%</td>
<td>13%</td>
</tr>
<tr>
<td>Books</td>
<td>14%</td>
<td>17%</td>
</tr>
<tr>
<td>Conferences-seminars provided by vendors</td>
<td>16%</td>
<td>17%</td>
</tr>
<tr>
<td>Professional devpmnt courses by university online</td>
<td>15%</td>
<td>13%</td>
</tr>
<tr>
<td>Certification training</td>
<td>10%</td>
<td>8%</td>
</tr>
<tr>
<td>Professional devpmnt courses by univ ext progs</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Conf/seminars provided by professional assocns</td>
<td>7%</td>
<td>9%</td>
</tr>
<tr>
<td>Conferences-seminars by media orgs (like ESC)</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>No formal advancing of my professional skills</td>
<td>7%</td>
<td>9%</td>
</tr>
<tr>
<td>Other</td>
<td>6%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Technical Reading

<table>
<thead>
<tr>
<th>2019</th>
<th>2017</th>
<th>2015</th>
<th>2014</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average days per year spent on career training</td>
<td>8.1</td>
<td>9.7</td>
<td>9.5</td>
<td>9.2</td>
</tr>
<tr>
<td>Hours per week spent reading technical publications</td>
<td>4.7</td>
<td>4.8</td>
<td>4.6</td>
<td>5.2</td>
</tr>
<tr>
<td>Technical books read in full or in substantial part per year</td>
<td>3.2</td>
<td>3.2</td>
<td>3.7</td>
<td>3.9</td>
</tr>
</tbody>
</table>
Embedded Design Challenges

- **Challenges** – Meeting schedules (22%) and debugging (22%).
- **Stages** – Detailed design (31%) & testing/debugging (19%) take most time.
- **Vendors** – Work with 2.7 outside vendors on average (same as 2017).
- **Most Need to Improve** – Engineering team skill level (20%), debugging tools (20%), and schedule (12%). Team skills for EMEA (24%) and APAC (26%).
- **Sources of Info** – Vendor websites (83%) leads all others by far. Search engines (54%) and technical white papers (51%) also important.
- **Technical Challenges for Next Year** – Top three: Integrating new technology (20%), managing code size and complexity (16%) and security (15%).
- **Favorite Tools** – Top four: Oscilloscope (43%), debugger (41%), compiler (35%) and IDE (32%).
- **Maintaining professional skills** – Top four: Vendor online training/webinars (43%), vendor technical white papers (40%), professional/technical journals (34%) and online training/webinars by media organizations (32%).
- **Training/reading**: 8.1 days/year career training; 26.3 years out of school; 4.7 hours per week reading technical publications; read 3.1 books per year.
OPERATING SYSTEMS
Does your current embedded project use an operating system, RTOS, kernel, software executive, or scheduler of any kind?

81% of those not using OS/RTOSes, said the main reason for NOT using is simply that they are not needed.
### My current embedded project uses:

<table>
<thead>
<tr>
<th>Option</th>
<th>2019 (N = 393)</th>
<th>2017 (N = 539)</th>
<th>2015 (N = 804)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-source OS/RTOS, without commercial support</td>
<td>42%</td>
<td>41%</td>
<td>39%</td>
</tr>
<tr>
<td>Commercial OS/RTOS</td>
<td>24%</td>
<td>30%</td>
<td>35%</td>
</tr>
<tr>
<td>Internally developed or in-house OS/RTOS</td>
<td>19%</td>
<td>17%</td>
<td>15%</td>
</tr>
<tr>
<td>Commercial distribution of an open-source OS/RTOS</td>
<td>16%</td>
<td>12%</td>
<td>11%</td>
</tr>
</tbody>
</table>

### My next embedded project will likely use:

<table>
<thead>
<tr>
<th>Option</th>
<th>2019 (N = 474)</th>
<th>2017 (N = 647)</th>
<th>2015 (N = 954)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-source OS/RTOS, without commercial support</td>
<td>49%</td>
<td>43%</td>
<td>41%</td>
</tr>
<tr>
<td>Commercial OS/RTOS</td>
<td>24%</td>
<td>28%</td>
<td>32%</td>
</tr>
<tr>
<td>Internally developed or in-house OS/RTOS</td>
<td>13%</td>
<td>13%</td>
<td>10%</td>
</tr>
<tr>
<td>Commercial distribution of an open-source OS/RTOS</td>
<td>14%</td>
<td>15%</td>
<td>17%</td>
</tr>
</tbody>
</table>
Which factors most influenced your decision to use a commercial operating system?

**Top 19 reasons**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time capability</td>
<td>42%</td>
</tr>
<tr>
<td>Good software tools</td>
<td>36%</td>
</tr>
<tr>
<td>Ease of future maintenance</td>
<td>35%</td>
</tr>
<tr>
<td>Technical support</td>
<td>33%</td>
</tr>
<tr>
<td>Code size / memory usage</td>
<td>33%</td>
</tr>
<tr>
<td>Processor or hardware compatibility</td>
<td>32%</td>
</tr>
<tr>
<td>Support for my processor &amp; drivers (BSP)</td>
<td>30%</td>
</tr>
<tr>
<td>Royalty-free</td>
<td>28%</td>
</tr>
<tr>
<td>Documentation</td>
<td>23%</td>
</tr>
<tr>
<td>Networking capability</td>
<td>23%</td>
</tr>
<tr>
<td>Security</td>
<td>23%</td>
</tr>
<tr>
<td>Overall cost</td>
<td>22%</td>
</tr>
<tr>
<td>Supplier's reputation</td>
<td>18%</td>
</tr>
<tr>
<td>Context switch time</td>
<td>18%</td>
</tr>
<tr>
<td>Modularity</td>
<td>18%</td>
</tr>
<tr>
<td>Scheduling efficiency</td>
<td>17%</td>
</tr>
<tr>
<td>Customer's desire</td>
<td>16%</td>
</tr>
<tr>
<td>Multicore support</td>
<td>15%</td>
</tr>
<tr>
<td>Safety Certification</td>
<td>12%</td>
</tr>
</tbody>
</table>

Base = Those who currently use a “Commercial” OS/RTOS

© 2019 Copyright by AspenCore. All rights reserved.
What are your reasons for not using a commercial operating system?

- Current solution works fine: 65% (2019) vs 68% (2017)
- Commercial alternatives too expensive: 27% (2019) vs 35% (2017)
- Avoid reliance on commercial supplier: 24% (2019) vs 28% (2017)
- No need for mulithreading multitasking: 21% (2019) vs 20% (2017)
- Too much trouble to learn commercial alternative: 12% (2019) vs 11% (2017)
- No need for real time: 11% (2019) vs 9% (2017)
- Incompatible for existing software, apps or drivers: 10% (2019) vs 11% (2017)
- Commercial alternatives use too much memory: 8% (2019) vs 11% (2017)
- Security concerns with commercial: 8% (2019) vs 8% (2017)
- Safety concerns with commercial alternatives: 6% (2019) vs 7% (2017)
- Commercial alternatives lack features I need: 5% (2019) vs 6% (2017)
- Other: 9% (2019) vs 8% (2017)

Base = Those who do not currently use a “Commercial” OS/RTOS
Did you use the same operating system, RTOS, or kernel as in your previous project?

Base: Those who use operating systems
Why did you use the same operating system?

- Happy with current one, no reason to switch (69% in 2019, 70% in 2017)
- Wanted to maintain software compatibility (37% in 2019, 39% in 2017)
- Wanted to make use of expertise/familiarity (36% in 2019, 38% in 2017)
- Wanted to maintain the same tools or software (33% in 2019, 35% in 2017)
- Wanted to keep same Operating System (25% in 2019, 28% in 2017)
- Switching OS too expensive / time-consuming (19% in 2019, 20% in 2017)
- Happy with supplier (11% in 2019, 12% in 2017)
- No other suitable alternatives available (6% in 2019, 7% in 2017)
- Not my choice/operating system chosen for me (6% in 2019, 5% in 2017)
- Other (3% in 2019, 4% in 2017)

Base = Those who are using the same operating system as in previous project
Why did you switch operating systems?

- Hardware or processor changed: 36% (2019) vs 36% (2017)
- Not my choice/OS chosen for me: 24% (2019) vs 23% (2017)
- New OS had better features: 16% (2019) vs 19% (2017)
- New OS had better SW/dev tools: 14% (2019) vs 13% (2017)
- New OS is cheaper: 11% (2019) vs 10% (2017)
- New OS had better growth path: 10% (2019) vs 12% (2017)
- New OS had OTS modules (apps, tools): 7% (2019) vs 9% (2017)
- Previous OS no longer available: 6% (2019) vs 7% (2017)
- Previous OS too slow: 5% (2019) vs 6% (2017)
- Unhappy with previous OS supplier: 5% (2019) vs 5% (2017)
- Other: 12% (2019) vs 15% (2017)
What are the most important factors in choosing an operating system?

- Availability of tech support: 31% (2019), 27% (2017)
- Compatibility w/ other software, systems, tools: 29% (2019), 27% (2017)
- No royalties: 29% (2019), 27% (2017)
- Freedom to customize or modify: 26% (2019), 25% (2017)
- My familiarity with the operating system: 25% (2019), 20% (2017)
- Simplicity / ease of use: 15% (2019), 15% (2017)
- Popularity/large developer community: 15% (2019), 12% (2017)
- Purchase price: 14% (2019), 12% (2017)
- Small memory footprint: 12% (2019), 12% (2017)
- Software development tools available: 11% (2019), 11% (2017)
- The processors it supports: 13% (2019), 10% (2017)
- Successful prior use for similar apps: 8% (2019), 8% (2017)
- Other software, middleware, drivers, code available: 9% (2019), 8% (2017)

Base: Currently using an operating system
Please select ALL of the operating systems you are currently using.

- **Embedded Linux**: 21%
- **In-house/custom**: 19%
- **FreeRTOS**: 18%
- **Ubuntu**: 14%
- **Android**: 13%
- **Debian (Linux)**: 13%
- **Microsoft (Windows 10)**: 10%
- **Microsoft (Windows Embedded 7/Standard)**: 6%
- **Texas Instruments RTOS**: 5%
- **Wind River (VxWorks)**: 5%
- **Green Hills (INTEGRITY)**: 5%
- **Texas Instruments (DSP/BIOS)**: 5%
- **Micrium (uC/OS-II)**: 4%
- **AnalogDevices (VDK)**: 4%
- **Keil (RTX)**: 4%
- **Red Hat (IX Lunix)**: 3%
- **Microsoft (Windows 7 Compact or earlier)**: 3%
- **Express Logic (ThreadX)**: 3%
- **Micrium (uC/OS-III)**: 3%
- **QNX (QNX)**: 3%
- **Android Go (Google)**: 2%
- **Freescale MQX**: 2%
- **Wittenstein High Integrity Systems**: 2%
- **CMX**: 2%
- **Segger (embOS)**: 2%
- **LynuxWorks (LynxOS)**: 2%
- **Wind River (Linux)**: 2%
- **OSEK**: 2%
- **ECos**: 2%

### Regional Breakout

- **EMEA**: Uses Embedded Linux much more than other regions.
- **APAC**: Uses Android much more than other regions and uses Embedded Linux much less than others.

### Operating Systems Most Used

<table>
<thead>
<tr>
<th>Most Used</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Embedded Linux</strong></td>
<td>21%</td>
<td>21%</td>
<td><strong>30%</strong></td>
<td><strong>15%</strong></td>
</tr>
<tr>
<td><strong>Android (Google)</strong></td>
<td>13%</td>
<td>9%</td>
<td>14%</td>
<td><strong>27%</strong></td>
</tr>
</tbody>
</table>

Only Operating Systems with 2% or more are shown.

2019 (N = 468)
Please select ALL of the operating systems you are considering using in the next 12 months.

- Embedded Linux: 31%
- FreeRTOS: 27%
- In-house/custom: 16%
- Debian (Linux): 15%
- Ubuntu: 14%
- Android: 14%
- Microsoft (Windows 10): 12%
- Texas Instruments RTOS: 9%
- Keil (RTX): 6%
- Other: 6%
- Micrium (uC/OS-III): 5%
- Red Hat (IX Lunix): 5%
- Texas Instruments (DSP/BIOS): 5%
- Wind River (VxWorks): 5%
- Green Hills (INTEGRITY): 5%
- QNX (QNX): 5%
- Express Logic (ThreadX): 4%
- Angstrom (Linux): 4%
- Wittenstein HIS(OpenRTOS/SAFERTOS: 4%
- Micrium (uC/OS-II): 4%
- Freescale MQX: 3%
- AnalogDevices (VDK): 3%
- Segger (embOS): 3%
- Wind River (Linux): 3%
- Microsoft (Windows 7 Compact or earlier): 3%

**Regional Breakout**

APAC users will use FreeRTOS and Android much more than other regions and use Embedded Linux much less. EMEA will use Android less than other regions.

<table>
<thead>
<tr>
<th>Operating System</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embedded Linux</td>
<td>31%</td>
<td>32%</td>
<td>31%</td>
<td>26%</td>
</tr>
<tr>
<td>FreeRTOS</td>
<td>27%</td>
<td>25%</td>
<td>24%</td>
<td>37%</td>
</tr>
<tr>
<td>Android</td>
<td>14%</td>
<td>12%</td>
<td>10%</td>
<td>26%</td>
</tr>
</tbody>
</table>

Only Operating Systems with 3% more are shown

Base: Those who are considering an operating system in any project in the next 12 months
Are you currently using embedded virtualization/hypervisors or will you likely use them in the next 12 months?

Top reasons for using virtualization/hypervisors

<table>
<thead>
<tr>
<th>Reason</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Separation of multiple applications</td>
<td>45</td>
</tr>
<tr>
<td>Need to support multiple guest operating systems (e.g., Android, VxWorks, Linux)</td>
<td>40</td>
</tr>
<tr>
<td>Need to support hard real-time application(s) and guest operating system</td>
<td>32</td>
</tr>
<tr>
<td>Processor consolidation</td>
<td>26</td>
</tr>
<tr>
<td>Need to support legacy and new applications on the same system</td>
<td>26</td>
</tr>
</tbody>
</table>
Operating Systems

- **OS/RTOS usage** – 65% overall usage, down from 2017 (67%) and 2015 (72%).

- **Open Source OS/RTOS usage** – 41%, projected for next project at 49%. Usage of commercial OSes (24%) dipped to an all time low from 40% in 2012.

- **Used same OS** – 60% used the same OS, same as 2017. Reasons for using the same OS: happy (69%), compatibility (37%), familiarity (37%), same tools (33%).

- **Reasons for Switching OS** – Hardware/processor changed (36%), chosen for me (24%), new one had better features (16%).

- **Reason for choosing OS** – Full source code (35%), tech support (31%), compatibility (29%), no royalties (29%). Same as 2017, slightly different rankings.

- **OS/RTOS used** – Embedded Linux (21%), Inhouse (19%), FreeRTOS (18%). EMEA uses Embedded Linux (30%). APAC uses Android (27%).

- **OS/RTOS considering** – Embedded Linux (31%), FreeRTOS (27%), Inhouse (16%) were top three RTOSes being considered. APAC users will consider FreeRTOS (37%) and Android (26%).

- **Embedded virtualization/hypervisor usage** – 17%, up from 15% in 2017. Use it mostly for separation of multiple applications (45%) and multiple guest OSes (40%).
MICROPROCESSORS
Who were the greatest influences on the choice of the processor for your current project?

<table>
<thead>
<tr>
<th>Influence</th>
<th>2019 (%)</th>
<th>2017 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware engineering staff</td>
<td>28%</td>
<td>33%</td>
</tr>
<tr>
<td>Group decision in engineering</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td>Hardware engineering mngr</td>
<td>21%</td>
<td>22%</td>
</tr>
<tr>
<td>Software engineering staff</td>
<td>22%</td>
<td>22%</td>
</tr>
<tr>
<td>Software engineering mngr</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>Corporate mgmt.</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Same processor as in previous project</td>
<td>9%</td>
<td>9%</td>
</tr>
<tr>
<td>Systems engineering staff</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Systems engineering mngr</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Outside influence/customer/standards</td>
<td>6%</td>
<td>8%</td>
</tr>
<tr>
<td>Purchasing mgr. or dept.</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>Marketing mngr or dept.</td>
<td>3%</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>

2019 (N = 556)  
2017 (N = 758)
Who were the greatest influences on the choice of the processor for your current project? (Regional Detail)

**Americas (N = 350)**
- 39% HW engineering staff
- 27% Group decision in Engineering
- 17% HW engineering manager
- 26% SW engineering staff
- 13% SW engineering manager

**EMEA (N = 110)**
- 25% HW engineering staff
- 26% Group decision in Engineering
- 30% HW engineering manager
- 15% SW engineering staff
- 12% SW engineering manager

**APAC (N = 96)**
- 23% HW engineering staff
- 25% Group decision in Engineering
- 34% HW engineering manager
- 13% SW engineering staff
- 20% SW engineering manager

**Americas top two influences**
1. HW engineering STAFF
2. Group decision in Engineering

**EMEA top two influences**
1. HW engineering MANAGERS
2. Group decision in Engineering

**APAC top two influences**
1. HW engineering MANAGERS
2. Group decision in Engineering
My current embedded project contains:

- A single microprocessor/microcontroller (can be multicore): 57% in 2019, 56% in 2017, 58% in 2015, 50% in 2014, 52% in 2013
- 2 processors/microcontrollers: 21% in 2019, 22% in 2017, 27% in 2015, 24% in 2014, 22% in 2013
- 3–5 processors/microcontrollers: 17% in 2019, 15% in 2017, 13% in 2015, 16% in 2014, 16% in 2013
- 6–10 processors/microcontrollers: 3% in 2019, 4% in 2017, 3% in 2015, 3% in 2014, 4% in 2013
- >10 processors/microcontrollers: 3% in 2019, 3% in 2017, 3% in 2015, 3% in 2014, 4% in 2013

65% of EMEA designs contained a single processor.

The average number of microprocessors/microcontrollers per project was:

- 2.2 in 2019
- 2.3 in 2017
- 2.1 in 2015
- 2.4 in 2014
- 2.4 in 2013
Does your embedded project contain…

- Multiple different processor chips from diff. vendors: 29% (2019), 27% (2017), 24% (2015)
- Single chip/SoC with multiple identical processor cores: 26% (2019), 18% (2017), 18% (2015)
- Multiple identical processor chips: 19% (2019), 16% (2017), 13% (2015)
- Multiple different processor chips (same vendor): 15% (2019), 13% (2017), 12% (2015)
My current embedded project's main processor is a:

- 8-bit processor: 10% (2019), 11% (2017), 9% (2015), 12% (2014), 9% (2013)

71% of EMEA users use 32-bit chips as their main processor.

Additional chips to the main processor:
- Primarily 8-bit processors: 19%
- Primarily 16-bit processors: 15%
- Primarily 32-bit processors: 55%
- Primarily 64-bit processors: 12%
My current embedded project's main processor clock rate is:

The average processor clock rate was:
- 462 MHz in 2019
- 445 MHz in 2017
- 397 MHz in 2015
- 428 MHz in 2014
Did you use the same processor as in your previous embedded project?

62% of APAC users used the same processor as in their previous project.

Did you use the same processor as in your previous embedded project?

- Yes, used the same processor as in previous embedded project:
  - 2019 (N = 560): 53%
  - 2017 (N = 759): 47%
  - 2015 (N = 1,029): 50%
  - 2014 (N = 1,380): 47%
  - 2013 (N = 2,047): 50%

- No, did not use the same processor as in previous project:
  - 2019 (N = 560): 47%
  - 2017 (N = 759): 53%
  - 2015 (N = 1,029): 50%
  - 2014 (N = 1,380): 55%
  - 2013 (N = 2,047): 55%
Why did you use the same processor?

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happy with current processor/supplier</td>
<td>62%</td>
</tr>
<tr>
<td>To maintain software compatibility</td>
<td>54%</td>
</tr>
<tr>
<td>To make use of expertise/familiarity</td>
<td>47%</td>
</tr>
<tr>
<td>To maintain the same tools or software</td>
<td>46%</td>
</tr>
<tr>
<td>To use same operating system</td>
<td>27%</td>
</tr>
<tr>
<td>Switching too expensive/time consuming</td>
<td>20%</td>
</tr>
<tr>
<td>Not my choice/processor chosen for me</td>
<td>9%</td>
</tr>
<tr>
<td>No other suitable processors available</td>
<td>4%</td>
</tr>
<tr>
<td>Other</td>
<td>2%</td>
</tr>
</tbody>
</table>

Base = Those who used the same processor as in previous project

2019 (N = 276)
What were your reasons for switching processors?

- New processor has better features: 39%
- Too slow: needed increased performance/bit width: 19%
- New processor has better future growth path / roadmap: 19%
- New processor has better software / development tools: 17%
- Previous processor too slow (needed higher clock speed): 17%
- Not my choice / processor chosen for me: 17%
- Previous processor no longer available: 12%
- Needed a lower power processor: 13%
- To change operating system: 7%
- Previous processor too expensive: 7%
- Unhappy with previous processor's supplier: 2%
- Other: 9%

Base = Those who used the same processor as in previous project

2019 (N = 248)
**Did you…**

<table>
<thead>
<tr>
<th>2019 (N = 239)</th>
<th>2017 (N = 370)</th>
<th>2015 (N = 473)</th>
<th>2014 (N = 687)</th>
<th>2013 (N = 1088)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose a processor from a different family, architecture, or instruction set</td>
<td>58%</td>
<td>55%</td>
<td>57%</td>
<td>56%</td>
</tr>
<tr>
<td>Choose a different processor from the same family, architecture, or instruction set</td>
<td>42%</td>
<td>45%</td>
<td>43%</td>
<td>44%</td>
</tr>
</tbody>
</table>

Base = Those who did not use the same processor as in previous project
What’s most important when choosing a microprocessor?

- **The chip itself**: 31% (2019), 25% (2017), 26% (2015)
- **The ecosystem surrounding the chip (software, tools, support, etc.)**: 60% (2019), 68% (2017), 67% (2015)
- **The chip's supplier/vendor**: 9% (2019), 7% (2017), 8% (2015)
Which vendor has the best ecosystem for your needs?

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas Instruments/TI</td>
<td>16%</td>
</tr>
<tr>
<td>STMicroelectronics</td>
<td>15%</td>
</tr>
<tr>
<td>Microchip /Atmel</td>
<td>13%</td>
</tr>
<tr>
<td>NXP/Freescale</td>
<td>10%</td>
</tr>
<tr>
<td>Intel/Altera</td>
<td>4%</td>
</tr>
<tr>
<td>DigiKey</td>
<td>3%</td>
</tr>
<tr>
<td>Xilinx</td>
<td>3%</td>
</tr>
<tr>
<td>Renesas</td>
<td>3%</td>
</tr>
<tr>
<td>ARM</td>
<td>2%</td>
</tr>
<tr>
<td>Microsoft</td>
<td>2%</td>
</tr>
<tr>
<td>Analog Devices</td>
<td>1%</td>
</tr>
<tr>
<td>Avnet</td>
<td>1%</td>
</tr>
<tr>
<td>Mouser</td>
<td>1%</td>
</tr>
<tr>
<td>Nordic Semiconductor</td>
<td>1%</td>
</tr>
<tr>
<td>Silicon Labs</td>
<td>1%</td>
</tr>
<tr>
<td>ADI</td>
<td>1%</td>
</tr>
<tr>
<td>Arrow</td>
<td>1%</td>
</tr>
<tr>
<td>Cadence</td>
<td>1%</td>
</tr>
</tbody>
</table>

(Unaided Open End) 2019 (N = 236)
What are the most important factors in choosing a processor?

- Software development tools available: 63% (2019), 70% (2017), 71% (2015)
- Available software, middleware, drivers, existing code: 33% (2019), 33% (2017), 34% (2015)
- The chip's cost: 31% (2019), 34% (2017), 36% (2015)
- HW development tools available: 29% (2019), 31% (2017), 36% (2015)
- The operating systems it supports: 23% (2019), 25% (2017), 29% (2015)
- The on-chip I/O or peripherals: 23% (2019), 24% (2017), 24% (2015)
- The chip's power consumption: 19% (2019), 17% (2017), 18% (2015)
- The supplier's reputation: 14% (2019), 16% (2017), 12% (2015)
- Familiarity w/ architecture/chip family: 11% (2019), 13% (2017), 13% (2015)
- The chip's security features: 8% (2019), 6% (2017), 5% (2015)
- The processor’s debug support: 7% (2019), 7% (2017), 7% (2015)
Please select the processor vendors you are familiar with.

Merged Brands Combined

<table>
<thead>
<tr>
<th>Brands</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microchip/Atmel/Microsemi (Net)</td>
<td>63</td>
</tr>
<tr>
<td>NXP/Freescale (Net)</td>
<td>56</td>
</tr>
<tr>
<td>Intel/Altera (Net)</td>
<td>56</td>
</tr>
<tr>
<td>Cypress/Spansion (Net)</td>
<td>30</td>
</tr>
<tr>
<td>Silicon Labs/Energy (Net)</td>
<td>25</td>
</tr>
</tbody>
</table>

Top Four Brands by Region:

- **Americas**: TI, Microchip, Atmel, Freescale.
- **EMEA**: STMicro, Atmel, TI, NXP
- **APAC**: TI, Atmel, NXP, Microchip

2019 (N = 478)
Please select the processor vendors you are currently using.

- **Texas Instruments**: 27%
- **STMicroelectronics**: 26%
- **Atmel (now Microchip)**: 22%
- **Microchip Technology**: 22%
- **Freescale (now NXP)**: 21%
- **NXP**: 17%
- **Altera (Intel FPGA)**: 16%
- **Xilinx**: 16%
- **Intel**: 14%
- **Analog Devices**: 11%
- **Silicon Labs**: 10%
- **Renesas**: 9%
- **Cypress Semiconductor**: 9%
- **Broadcom**: 6%
- **AMD**: 5%
- **Lattice Semiconductor**: 4%
- **Maxim**: 4%
- **Microsemi (now Microchip)**: 4%
- **Infineon**: 4%
- **NVIDIA**: 4%
- **Qualcomm**: 3%
- **Marvell**: 3%
- **Energy Micro (now SiLabs)**: 3%
- **Digi/Rabbit Semiconductor**: 2%
- **Samsung**: 2%
- **IBM**: 2%
- **Applied Micro**: 2%
- **Cavium**: 2%
- **Cirrus Logic**: 1%
- **Toshiba**: 1%
- **Spansion (now Cypress)**: 1%

**Merged Brands Combined**
- **Microchip/Atmel/Microsemi (Net)**: 40%
- **NXP/Freescale (Net)**: 28%
- **Intel/Altera (Net)**: 26%
- **Silicon Labs/Energy (Net)**: 10%
- **Cypress/Spansion (Net)**: 9%

**Top Four Brands by Region:**
- **Americas**: TI, Microchip, STMicro, Atmel
- **EMEA**: STMicro, NXP, TI, Atmel
- **APAC**: TI, Atmel, Freescale, STMicro

2019 (N = 458)
Please select the processor vendors you are considering using on your next project.

- Texas Instruments: 34%
- STMicroelectronics: 32%
- Microchip Technology: 23%
- Atmel (now Microchip): 23%
- Altera (Intel FPGA): 23%
- Freescale (now NXP): 23%
- NXP: 21%
- Xilinx: 20%
- Intel: 14%
- Silicon Labs: 11%
- Renesas: 11%
- Analog Devices: 10%
- Cypress Semiconductor: 10%
- Broadcom: 8%
- AMD: 7%
- Infineon: 7%
- Microsemi (now Microchip): 7%
- Qualcomm: 6%
- Energy Micro (now Silicon Labs): 6%
- Maxim: 5%
- Lattice Semiconductor: 4%
- NVIDIA: 4%
- Samsung: 3%
- IBM: 3%
- Zilog: 3%
- Marvell: 2%
- Applied Micro: 2%
- Digi/Rabbit Semiconductor: 2%
- Cavium: 2%
- Cirrus Logic: 2%
- Toshiba: 2%
- PMC-Sierra: 1%
- Spansion (now Cypress): 1%

**Merged Brands Combined**

- Microchip/Atmel/Microsemi (Net): 39%
- NXP/Freescale (Net): 33%
- Intel/Altera (Net): 31%
- Silicon Labs/Energy (Net): 13%
- Cypress/Spansion (Net): 10%

**Top Four Brands by Region:**
- **Americas:** TI, STMicro, Microchip, Atmel
- **EMEA:** STMicro, TI, NXP, Altera
- **APAC:** STMicro, TI, Freescale, NXP

2017 (N = 554)
Which of the following 32-bit chip families would you consider for your next embedded project?

<table>
<thead>
<tr>
<th>Chip Family</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>STMicroelectronics STM32 (ARM)</td>
<td>31%</td>
</tr>
<tr>
<td>Atmel/Microchip SAMxx (ARM)</td>
<td>21%</td>
</tr>
<tr>
<td>Microchip PIC 32-bit (MIPS)</td>
<td>19%</td>
</tr>
<tr>
<td>Freescale/NXP i.MX (ARM)</td>
<td>15%</td>
</tr>
<tr>
<td>NXP LPC (ARM)</td>
<td>15%</td>
</tr>
<tr>
<td>Freescale/NXP Kinetis (ARM/Cortex-M4/M0)</td>
<td>14%</td>
</tr>
<tr>
<td>Xilinx Zynq (with dual ARM Cortex-A9)</td>
<td>14%</td>
</tr>
<tr>
<td>TI MSP432</td>
<td>13%</td>
</tr>
<tr>
<td>Atmel/Microchip AVR32</td>
<td>12%</td>
</tr>
<tr>
<td>Altera (Intel FPGA) SoC-FPGA (with dual ARM Cortex-A9)</td>
<td>12%</td>
</tr>
<tr>
<td>Altera (Intel FPGA) Nios II (soft core)</td>
<td>11%</td>
</tr>
<tr>
<td>Arduino</td>
<td>11%</td>
</tr>
<tr>
<td>TI Sitara (ARM)</td>
<td>11%</td>
</tr>
<tr>
<td>Atmel/Microchip AT91xx/ATSAMxx (ARM)</td>
<td>10%</td>
</tr>
<tr>
<td>Cypress PSOC 4 (ARM Cortex-M0) / PSoC 5 (ARM...)</td>
<td>9%</td>
</tr>
<tr>
<td>Intel Atom, Pentium, Celeron, Core 2, Core iX</td>
<td>8%</td>
</tr>
<tr>
<td>SiLABS EFM32/Tiny or Giant Gecko</td>
<td>8%</td>
</tr>
<tr>
<td>TI SimpleLink (ARM)</td>
<td>7%</td>
</tr>
<tr>
<td>Xilinx MicroBlaze (soft-core)</td>
<td>7%</td>
</tr>
<tr>
<td>Broadcom (any)</td>
<td>6%</td>
</tr>
<tr>
<td>TI Tiva (ARM)</td>
<td>6%</td>
</tr>
<tr>
<td>Renesas Synergy (ARM Cortex-M)</td>
<td>6%</td>
</tr>
<tr>
<td>TI OMAP</td>
<td>6%</td>
</tr>
<tr>
<td>STMicroelectronics STMicrocontrollers</td>
<td>5%</td>
</tr>
<tr>
<td>STMicroelectronics STMicrocontrollers</td>
<td>5%</td>
</tr>
<tr>
<td>Renesas RX</td>
<td>4%</td>
</tr>
<tr>
<td>Xilinx Virtex-5 (with PowerPC 405)</td>
<td>3%</td>
</tr>
<tr>
<td>Energy Micro/Silabs EFM32</td>
<td>3%</td>
</tr>
<tr>
<td>Atmel/Microchip AT91xx</td>
<td>3%</td>
</tr>
<tr>
<td>Microsemi/Microchip SmartFusion SoC FPGA (Cortex-M0)</td>
<td>2%</td>
</tr>
<tr>
<td>Microsemi/Microchip SmartFusion SoC FPGA (Cortex-M0)</td>
<td>2%</td>
</tr>
<tr>
<td>Qualcomm (any)</td>
<td>2%</td>
</tr>
<tr>
<td>NXP MPC5xxx</td>
<td>2%</td>
</tr>
<tr>
<td>Freescale/NXP PowerPC 55xx</td>
<td>2%</td>
</tr>
<tr>
<td>Microsemi/Microchip FPGA (Cortex-M1, softcore)</td>
<td>2%</td>
</tr>
<tr>
<td>NVIDIA Tegra</td>
<td>2%</td>
</tr>
<tr>
<td>SiLABS Precision32 (ARM)</td>
<td>2%</td>
</tr>
<tr>
<td>TI Hercules (ARM)</td>
<td>2%</td>
</tr>
<tr>
<td>AMD Fusion, Athlon, Sempron, Turion, Opteron,...</td>
<td>2%</td>
</tr>
<tr>
<td>Xilinx Virtex-4 (with PowerPC 405)</td>
<td>2%</td>
</tr>
<tr>
<td>Freescale/NXP PowerPC 5xx, 6xx</td>
<td>2%</td>
</tr>
<tr>
<td>Infineon Tricore</td>
<td>2%</td>
</tr>
<tr>
<td>Infineon XMC4000 (ARM)</td>
<td>2%</td>
</tr>
<tr>
<td>Marvell</td>
<td>2%</td>
</tr>
<tr>
<td>Freescale/NXP PowerPC 7xx, 8xx</td>
<td>2%</td>
</tr>
<tr>
<td>Freescale/NXP 68K, ColdFire</td>
<td>2%</td>
</tr>
<tr>
<td>Infineon AURIX (TriCore-based)</td>
<td>2%</td>
</tr>
<tr>
<td>Renesas RH850</td>
<td>2%</td>
</tr>
<tr>
<td>Freescale/NXP Vybrid (ARM)</td>
<td>2%</td>
</tr>
<tr>
<td>Infineon XMC1000 (ARM Cortex-M0)</td>
<td>1%</td>
</tr>
<tr>
<td>AMD Alchemy (MIPS)</td>
<td>1%</td>
</tr>
<tr>
<td>Freescale/NXP PowerQUICC</td>
<td>1%</td>
</tr>
<tr>
<td>Spansion/Cypress FM3 (ARM)</td>
<td>1%</td>
</tr>
<tr>
<td>AMCC PowerPC 4xx</td>
<td>1%</td>
</tr>
<tr>
<td>IBM PowerPC 4xx, 7xx</td>
<td>1%</td>
</tr>
<tr>
<td>SPARC (any)</td>
<td>1%</td>
</tr>
<tr>
<td>Infineon other TriCore-based 32-bit families (i.e...</td>
<td>1%</td>
</tr>
</tbody>
</table>

2019 (N = 469)
Which of the following 16-bit chip families would you consider for your next embedded project?

- **TI MSP430**: 47% (2019), 42% (2017)
- **Microchip PIC24 / dsPIC**: 41% (2019), 45% (2017)
- **Freescale/NXP HC16**: 17% (2019), 15% (2017)
- **Intel 8086, '186, '286**: 14% (2019), 11% (2017)
- **Renesas RL78**: 11% (2019), 11% (2017)
- **Freescale/NXP HC12**: 7% (2019), 10% (2017)
- **Infineon XE166, XC2000, XC166, C166**: 4% (2019), 6% (2017)
- **Renesas R8C**: 7% (2019), 9% (2017)
- **AMD 186, '188**: 6% (2019), 6% (2017)
- **Maxim**: 6% (2019), 4% (2017)
- **Zilog Z180, Z380**: 4% (2019), 5% (2017)
- **Other**: 3% (2019), 7% (2017)

By Regions

<table>
<thead>
<tr>
<th>Chip Family</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>TI MSP430</td>
<td>47%</td>
<td>50%</td>
<td>36%</td>
<td>42%</td>
</tr>
<tr>
<td>Microchip PIC24/dsPIC</td>
<td>41%</td>
<td>41%</td>
<td>44%</td>
<td>39%</td>
</tr>
</tbody>
</table>

© 2019 Copyright by AspenCore. All rights reserved.
Which of the following 8-bit chip families would you consider for your next embedded project?

By Regions

<table>
<thead>
<tr>
<th>Chip Family</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atmel/Microchip AVR</td>
<td>44%</td>
<td>44%</td>
<td>52%</td>
<td>39%</td>
</tr>
<tr>
<td>Microchip PIC</td>
<td>38%</td>
<td>41%</td>
<td>43%</td>
<td>23%</td>
</tr>
<tr>
<td>STMicroelectronics ST8</td>
<td>25%</td>
<td>22%</td>
<td>31%</td>
<td>28%</td>
</tr>
<tr>
<td>TI TMS370, 7000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freescale/NXP HC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intel 80xx, '251</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atmel/Microchip 80xx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Renesas H8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Xilinx PicoBlaze (soft core)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SiLabs 80xx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NXP/Philips P80x, P87x, P89x</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cypress PSoC 1 (M8C) / PSoC 3 (8051)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zilog Z8, Z80, Z180, eZ80</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parallax</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maxim 80xx</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infineon XC800, C500</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EFM8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digi / Rabbit 2000, 3000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toshiba</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2019 (N = 351) vs 2017 (N = 462)
Have you upgraded from an 8-bit or 16-bit chip to a 32-bit design in the last 12 months?

Overall 23% upgraded. But for APAC, 39% upgraded, 23% from 8-bit chip, 16% from 16-bit chip.
Which of the following DSP chip families would you consider for your next embedded project?

<table>
<thead>
<tr>
<th>Chip Family</th>
<th>World</th>
<th>Americas</th>
<th>EMEA</th>
<th>APAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microchip dsPIC</td>
<td>26%</td>
<td>26%</td>
<td>36%</td>
<td>19%</td>
</tr>
<tr>
<td>Analog Devices Blackfin</td>
<td>18%</td>
<td>19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI DaVinci</td>
<td>18%</td>
<td>19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Devices SHARC</td>
<td>18%</td>
<td>19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI 'C6000</td>
<td>15%</td>
<td>17%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TI 'C5000</td>
<td>15%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NXP Cortex M4 LPC4000</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NXP Arm Cortex-M33</td>
<td>14%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Devices ADSP-21xx</td>
<td>13%</td>
<td>12%</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>TI KeyStone DSPs</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Analog Devices TigerSHARC</td>
<td>10%</td>
<td>12%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Freescale 563xx, 566xx, 568xx, 96xxx</td>
<td>9%</td>
<td>11%</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Freescale/NXP StarCore 3900</td>
<td>5%</td>
<td>6%</td>
<td>5%</td>
<td>6%</td>
</tr>
<tr>
<td>TI Jacinto</td>
<td>5%</td>
<td></td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>Freescale StarCore 71xx, 81xx</td>
<td>4%</td>
<td></td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>
Microprocessors

- **Deciders for chips – Overall**: Hardware engineers (33%) and engineering group (26%).
  - Americas top 2 influencers: 1. Hardware engineering **staff**; 2. Engineering **group**.
  - EMEA top 2 influencers: 1. Hardware engineering **managers**, 2. Engineering **group**.
  - APAC top 2 influences: 1. Hardware engineering **managers**, 2. Engineering **group**.
- **Single processor usage** – 57% worldwide (65% in EMEA) with 2.2 processors per design on average.
- **Chip Mix**: Multiple different processors from different vendors (29%). Single chip/multiple cores (26%).
- **Chip Type** – In 2019: 32-bit (61%), 64-bit (15%), 16-bit (11%), 8-bit (10%).
- **Clock speeds** – Now averages 462 MHz, up from 445 MHz in 2017.
- **Same processor used** – Now 53%, up 6% from 2017. Reasons: Happy, compatibility, familiarity, same tools.
- **Family** – 58% chose main chip from different family, 42% chose different processor from the same family.
- **Ecosystem** – 60% say “ecosystem” outweighs “the chip” (31%). Best ecosystems are TI (16%), Microchip (15%).
- **Most important in chip decision** – 1. Software development tools (63%), 2. Chip performance (41%).
- **Top five Vendors Familiar With** – TI, Atmel, Microchip, Freescale, STMicroelectronics.
- **Top five Vendors Currently Using** – TI, STMicroelectronics, Atmel, Microchip, Freescale.
- **Top three 32-bit chips considering** – STMicro STM32 (ARM), Atmel SAMxx (ARM), Microchip PIC 32-bit.
- **Top two 16-bit chips considering** – TI MSP430 and Microchip PIC 24 (dsPIC) (same, but reversed from 2017).
- **Top two 8-bit chips considering** – Atmel AVR and Microchip PIC (same, but reversed from 2017).
- **Upgraded from 8 or 16-bit to 32-bit** – Overall 23%. For APAC 39% upgraded.
- **Top four DSP chips considering** – Microchip dsPIC, Analog Devices Blackfin, TI DaVinci, Analog Devices SHARC.
FPGA CHIPS
Does your current embedded project incorporate an FPGA chip?

Among those not using FPGAs, only 13% said the trend towards FPGAs with built-in multicore processors would change their mind.

27% of all respondents said they would use an FPGA in their next project. Those not using FPGAs in the future say they “don’t need the functionality,” “FPGAs are too expensive,” “consume too much power,” “are too difficult to program.”
Which of the following vendors does your current embedded project use for FPGAs?

<table>
<thead>
<tr>
<th>Vendor</th>
<th>2019 Currently use (N = 166)</th>
<th>2017 Currently use (N = 199)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xilinx</td>
<td>58%</td>
<td>55%</td>
</tr>
<tr>
<td>Altera (Intel FPGA)</td>
<td>50%</td>
<td>42%</td>
</tr>
<tr>
<td>Lattice Semiconductor</td>
<td>17%</td>
<td>13%</td>
</tr>
<tr>
<td>Microsemi (now Microchip)</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>Cypress Semiconductor</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Mentor Graphics</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Atmel (now Microchip)</td>
<td>4%</td>
<td>5%</td>
</tr>
<tr>
<td>Cadence</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Synopsys/Synplicity</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Achronix</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Other</td>
<td>2%</td>
<td>1%</td>
</tr>
</tbody>
</table>

Microchip Net = 11%
Which of the following FPGA vendors will you consider in your next embedded project?

- Xilinx: 70% (2019), 70% (2017)
- Cypress Semiconductor: 15% (2019), 17% (2017)
- Synopsys: 4% (2019), 5% (2017)
- Cadence: 4% (2019), 5% (2017)
- Achronix: 2% (2019), 2% (2017)
- Other: 2% (2019), 2% (2017)

Microchip Net = 25%
• **Current FPGA usage** – 33% used in current project.

• **Next Project FPGA usage** – 27% will likely use an FPGA in their next project. Again strong competition from Altera and Microchip will heat up this market.

• **Why FPGAs NOT used** – Don’t need this functionality, too expensive, use too much power, and too difficult to program – no change from 2017.

• **Built-in Multicore Trend** – 13% say it will encourage them to use FPGAs.

• **Vendors currently used** – Xilinx (58%) and Altera (50%) dominate, but the difference is the tightest its ever been in this study’s history. Lattice is a distant third at 17%. Altera has increased its usage, and Microchip is starting to show some gains as well due to its mergers with Atmel and Microsemi.

• **Vendors will consider** – Xilinx (70%) and Altera (59%). Altera/Intel and Atmel/Microsemi brands under Microchip portend a possible challenge to Xilinx and Lattice market share.
Hardware IP Reuse, Design Techniques, System Level Tools, Project & Version Control
Does your current embedded project reuse hardware or hardware IP from a previous project?

Over three quarters (77%) of embedded developers reuse hardware or hardware IP. 63% reuse hardware or hardware IP that was developed in house. Possibly a slight trend towards using more in-house hardware or hardware IP in future designs.
Which of the following design techniques will become more important to your designs in the future?

- **Simulation**: 61% (2019), 63% (2017), 56% (2015)
- **Emulation (added 2017)**: 33% (2019), 33% (2017), 33% (2015)
- **Modeling in a high level language**: 40% (2019), 27% (2017), 28% (2015)
- **Virtual prototyping**: 29% (2019), 28% (2017), 27% (2015)
- **Graphical system design**: 27% (2019), 25% (2017), 22% (2015)
- **Integrating with the cloud (added 2019)**: 18% (2019), 27% (2017), 22% (2015)
What system level design tools do you or your organization currently use?

<table>
<thead>
<tr>
<th>Tool</th>
<th>2019 (N = 342)</th>
<th>2017 (N = 445)</th>
<th>2015 (N = 638)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATLAB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LabVIEW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System C or other &quot;hardware C&quot; language</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulink</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FPGA-based prototypes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UML</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>QEMU</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cadence Virtual System Platform</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synopsys Virtualizer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mentor Graphics Vista</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
NEW IN 2019

What cloud integration tools do you or your organization currently use?

- **Firmware update**: 61%
- **Device management (including device shadows)**: 34%
- **Security management (including auth and commissioning)**: 31%
- **Other**: 15%

2019 (N = 220)
Who were the three greatest influencers on the choice of the system-level tools for your current project?

- Software engineering staff: 33%
- Hardware engineering staff: 26%
- Software engineering manager: 22%
- Hardware engineering manager: 18%
- Hardware architects: 17%
- Corporate management: 15%
- Systems engineering staff: 15%
- Systems engineering manager: 14%
- Outside influence, customer, standards: 9%
- Purchasing manager: 5%
- Marketing manager: 4%
- Other: 4%

2019 (N = 403)
Who were the three greatest influencers on the choice of the system-level tools for your current project? (Regional Detail)

**Americas (N = 265)**
- SW engineering staff: 37%
- HW engineering staff: 29%
- SW engineering manager: 22%
- HW engineering manager: 14%
- HW architects: 15%

**EMEA (N = 73)**
- SW engineering staff: 33%
- HW engineering staff: 23%
- SW engineering manager: 18%
- HW engineering manager: 16%
- HW architects: 19%

**APAC (N = 65)**
- SW engineering staff: 35%
- HW engineering staff: 28%
- SW engineering manager: 15%
- HW engineering manager: 12%
- HW architects: 22%

**Americas** top two influences:
1. SW engineering STAFF
2. HW engineering STAFF

**EMEA** top two influences:
1. SW engineering STAFF
2. HW engineering STAFF

**APAC** top two influences:
1. HW engineering MANAGERS
2. SW engineering MANAGERS
Which of the following project management software packages do you currently use?

- Microsoft Excel: 42% (2019), 44% (2017)
- Microsoft Project: 32% (2019), 38% (2017)
- Visio: 21% (2019), 22% (2017)
- Open Source tools: 21% (2019), 23% (2017)
- IBM Telelogic DOORS: 9% (2019), 6% (2017)
- Simulink: 5% (2019), 7% (2017)
- TeamCenter: 3% (2019), 3% (2017)
- Other software package: 10% (2019), 7% (2017)
Which of the following Version Control software systems do you currently use?

- **Git**: 38% (2015), 31% (2017), 46% (2019)
- **Subversion**: 27% (2015), 33% (2017), 41% (2019)
- **CVS**: 13% (2015), 14% (2017), 19% (2019)
- **Clearcase**: 6% (2015), 6% (2017), 10% (2019)
- **Perforce**: 4% (2015), 5% (2017), 7% (2019)
- **Other**: 10% (2015), 14% (2017), 17% (2019)
Hardware IPs, System Level Design, GUIs

- **Reuse of Hardware/Hardware IPs** – 77% trending up from 71% reuse in 2015.

- **Design Techniques Becoming More Important** – Top three are Simulation (56% -- down 7 points from 2017), emulation (33%) and modelling (28%).

- **System Level Design Tools Used** – MATLAB (46%) is the big leader, but trending down some, followed by LabVIEW (34%), System C (32%) and Simulink (24%).

- **Cloud Integration Tools Used** – Firmware updates (61%), Device management (34%). Security management (31%).

- **Deciders of Systems Level Tools** – Overall software engineers (33%) and hardware engineers (26%) are the top influencers on system level tools. But for APAC region hardware engineering managers (35%) and software engineering managers (28%) are the two leading influencers. Important when marketing to APAC.

- **Project Management** – Excel (42%) & Microsoft Project (32%) are tops as previously.

- **Version Control Software** – Git (46%) has completely overtaken Subversion (27%), and CVS (13%) is a distant third.
THANK YOU!