2014 Embedded Market Study Then, Now: What's Next?





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Purpose and Methodology

- Purpose: To profile the findings of the 2014 results of UBM Tech's <u>annual</u> <u>comprehensive survey</u> of the embedded systems markets worldwide. Findings include types of technology used, all aspects of the embedded development process, IoT emergence, tools used, work environment, applications, methods/ processes, operating systems used, reasons for using chips and technology, and brands and chips currently used by or being considered by embedded developers. Many questions in this survey are trended over <u>three to five years</u>.
- **Methodology**: A web-based online survey instrument based on the previous year's survey was developed and implemented by independent research company Wilson Research Group from January 18, 2014 to February 21, 2014 by email invitation
- **Sample:** E-mail invitations were sent to subscribers to UBM Tech Embedded Brands with one reminder invitation. Each invitation included a link to the survey.
- Returns: 2,258 valid respondents for an <u>overall</u> confidence of 95% +/- 2.0%. Confidence for questions with 1000 respondents = +/-3.0%, 400 respondents = +/-5.0%, this latter is considered a standard for most market research.

2014 Embedded Market Study

In which region of the world do you reside?



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How many employees does your company have at all locations?





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2014 Embedded Market Study

My job function includes:

Hardware/software integration Writing firmware/sftwr for embedded systems Debugging firmware/software Architecture selection/specification Firmware/software design or analysis **Debugging hardware** Project management Prototype testing Firmware/software testing Designing hardware for embedded systems Device programming System design Hardware/software co-design Board layout/design Hardware/software co-verification Connected device design SoC (system-on-chip) design Other



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For what types of <u>applications</u> are your embedded projects developed?



Current Embedded Design Environment



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My current embedded project is:

New to the world; a new project from scratch

An upgrade or improvement to an earlier or existing project





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What does the upgrade or improvement include?

13%

New or different software features

New or different processor

New or different connectivity capabilities*

Mandatory changes/discontinued hdwr/sftwr

New or different system logic

New or different peripherals*

New or different analog components

New or different operating system



Which of the following capabilities are included in your current embedded project?





If wireless, what wireless interfaces does your current embedded project include?





How many people are on your embedded project team?

Total Team 2014 =	14.0
 NonFirmware Software Engineer = 	3.5
- Hardware Engineer =	3.0
- Firmware Engineer =	2.9
- QA/Test Engineer =	2.1
- Systems/Integrator =	1.4
- Other Engineer =	1.0
Total Team 2013 =	14.6
Total Team 2013 = - Software Engineer =	14.6 4.0
Total Team 2013 = - Software Engineer = - Hardware Engineer =	14.6 4.0 2.9
Total Team 2013 = - Software Engineer = - Hardware Engineer = - Firmware Engineer =	14.6 4.0 2.9 2.7
Total Team 2013 = - Software Engineer = - Hardware Engineer = - Firmware Engineer = - QA/Test Engineer =	14.6 4.0 2.9 2.7 2.0
Total Team 2013 = - Software Engineer = - Hardware Engineer = - Firmware Engineer = - QA/Test Engineer = - Systems/Integrator =	14.6 4.0 2.9 2.7 2.0 1.5

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What is your development team's ratio of total resources (including time/dollars/manpower) spent on software vs. hardware for your embedded projects?



Note: Respondents averaged working on 2.0 projects at the same time.



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Do you primarily <u>build your own hardware</u> or do you primarily <u>outsource</u> your hardware requirements?



2014 (N = 1,594)

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Thinking now about the last embedded project you completed (no longer in development), how many months did that project take to finish?





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Was that project completed . . .



My current embedded project is programmed mostly in:



My next embedded project will likely be programmed mostly in:





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Note: C#, Python and Ada were added in 2013. Ada was under 1%. No other language is mentioned more than 6 times in the "Other" category

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Does your current project reuse code from a previous embedded project?



Current Embedded Design Environment: Key Takeaways

- Trend toward smaller teams
- Slow but steady trend toward **longer development cycles**
 - 12.6 months average in 2014 vs. 12.2 months average in 2010
- Meeting deadlines getting more and more difficult
 - "On schedule" project completion trending downward
 - 41% in 2014 while previous 4 years 42-44% for "Ahead of" or "On schedule"
- **No upstarts** in terms of programming languages
- **High** (86%) and **steady reuse of code** is expected to continue. Reused "purchased" code is declining.





Embedded Design Process



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Which of the following challenges are your own or your embedded design team's <u>greatest concerns</u> regarding your current embedded systems <u>development</u>?



The debugging process **Testing/Systems Integration** Increased lines of code & software complexity Meeting application performance standards* Sticking to our cost budget Keeping pace with embedded systems technology Meeting safety & development process standards* Power management/Energy efficiency Maintaining legacy code Selecting the right processors for the job Managing remote design team/multiple locations Software compatibility when porting to new devices* Outsourcing influence on embedded process Managing multiple operating environments Migrating to a multi-core processor Selecting the right debugging tool

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What percentage of your design time is spent on each of the following stages?

Developing system specs

Conceptual design stage

Detailed design stage

Simulation stage

Testing and debugging

Prototyping

Sending to production

Documentation/coding/mtgs



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How many external vendors do you work with on your design?

On average 3.0 vendors

How do you typically find and evaluate <u>partners</u> to work with?



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If you could improve one thing about your embedded design activities, what would it be?



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In general, what sources of information do you consult to research your embedded design decisions? Top 16 Sources



Thinking about the next year, what areas will be your greatest technology challenges? Managers Only





Which of the following are your favorite/most important software/hardware tools? (Top 18 shown)



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Which of the following software/hardware tools do you currently use? Only showing tools used by 17% or more.



What are the most effective ways that you systematically or formally maintain, educate, and advance your professional skills?

Training courses offered online Technical white papers by vendors Webinars provided by vendors Webinars by publications, media orgs Books Professional devlpmnt courses by private co. Conferences provided by vendors University professional dev. courses On-site seminars given by vendors Webinars by profsnl assocns Conference seminars by publctns, media orgs Conference seminars by profsnl assocns Certification training Other



Other Related Demographics	2014	2013
Average days per year spent on career training	9.2	9.0
Average number of years out of school	21.6	19.7
Hours per week spent reading technical pubs	5.2	4.8
Books read in full or in substantial part per year	3.9	3.9



Embedded Design Process: Key Takeaways

- Meeting schedules remains the premier challenge for development with the debugging process is not far behind.
- Time devoted to debugging is second only to "detailed design stage". Newly added "meeting performance standards" ranks 5^{th.}
- Design projects average **3 external vendors**, and these vendors are found largely through **referrals** and **web research**.
- Engineering team skill and scheduling increased in concern with debugging and programming tools decreasing in concern across improving embedded design activities over the last five years.
- Vendor websites continue to be extremely important to developers as sources of information, while newly-added technical standards, vendor technical support forums, and software APIs, show strength.
- Integrating new technology and managing code size are the number 1 and 2 technology challenges. OS/RTOS challenges have risen significantly from 12% in 2012-13 to 17% in 2014.
- Top five ways to maintain professional skills over last three years have been very consistent: training courses offered online; technical/white papers; webinars by vendors; webinars by media orgs. Online training courses and webinars from professional associations are steadily increasing over the last three years.



Operating Systems



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Does your current embedded project use an <u>operating system</u>, <u>RTOS</u>, <u>kernel</u>, <u>software executive</u>, or <u>scheduler</u> of any kind?

Hardly any change in usage of RTOS, kernels, execs, schedulers over past 5 years



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If current embedded project does <u>not</u> use an operating system, RTOS, kernel, software executive, or scheduler of any kind, <u>why not</u>?

83% 79% 79% 82% 81% 3% 5% 4% 14% 11% 2% 4% 4% 11% 9% 4% 4% 4% 2014 (N = 454) 6% 8% 2013 (N = 669) 1% 2% 4% 2012 (N = 541) 2011 (N = 561) 9% 9% 2010 (N = 458) 6% 6% 6% 8% Other

Current project doesn't need it

OS / RTOS uses too much memory

OS / RTOS requires too much processor power

OS / RTOS is too complicated to use

OS / RTOS is too expensive





My <u>current</u> embedded project uses:

My <u>next</u> embedded project will likely use:




Which factors most influenced your decision to use a commercial operating system? (Top 14 choices.)

Processor or hardware compatibility Real-time capability Good software tools Support for processor & drivers Technical support Ease of future maintenance Documentation Overall cost Royalty-free Code size/memory usage Supplier's reputation Networking capability Scheduling efficiency Context switch time



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What are your reasons for <u>not</u> using a commercial operating system?

58% Current solution works fine 61% 35% Commercial alternatives too expensive 36% 27% Avoid reliance on commercial supplier 28% 21% No need for multitasking 20% 12% Incompatible with existing SW apps or drivers 15% 10% Commercial alternatives use too much memory 12% ■ 2014 (N = 1109) ■ 2013 (N = 1503) 12% Too much trouble to learn commercial alternative 11% 7% Commercial alternatives lack features I need 7% 7% Other 8%

Who were the greatest influences on the choice of operating system?

Software engineering staff Software engineering manager Group decision within engineering Corporate management Hardware engineering manager Same OS as previous project Hardware engineering staff Systems engineering manager Systems engineering staff Outside influence/ customer/standards Marketing manager or department Purchasing manager or department





Did you use the same operating system, RTOS, or kernel as in your previous project?





Why did you use the same operating system?







Why did you switch operating systems?

Hardware or processor changed New OS had better features Not my choice/OS chosen for me New OS had better SW/dev tools New OS is cheaper New OS had better growth path New OS had OTS modules (apps, tools) Previous OS too slow Previous OS no longer available Unhappy with previous OS supplier Other



What are the most important factors in choosing an operating system?

Availability of full source code Availability of tech support No royalties Real-time performance Compatibility w/ other software, systems Freedom to customize or modify **Open-source** availability My familiarity with the operating system Purchase price Simplicity / ease of use The processors it supports Software-development tools available Small memory footprint Other software, middleware, drivers, code Commercial support Popularity Successful prior use for similar apps Rich selection of services and features





Please select ALL of the operating systems you are currently using.

18% Inhouse/custom 24% Android 17% 16% **FreeRTOS** 17% 13% 15% Ubuntu 13% 12% Debian (Linux) 8% 11% 11% Microsoft Windows Embedded 7 earlier 10% Micrium (uC/OS-II, III) 6% 8% Microsoft Windows 7 Compact earlier 8% 8% Wind River (VxWorks) 7% 8% Texas Instruments (DSP/BIOS) 7% 6% Angstrom (Linux) 4% Keil (RTX) 5% 5% Freescale MQX 5% QNX (QNX) 3% 4% 5% Red Hat (IX Linux) 2014 (N = 1,096) **Texas Instruments RTOS** 4% 4% ■ 2013 (N = 1,696) 4% 4% Wind River (Linux) 4% Mentor Graphics (Nucleus/Linux) (Net) 1% Base: Currently using 3% 4% Analog Devices (VDK) an operating system 3% 3% Green Hills (INTEGRITY) 3% Express Logic (ThreadX) 2% 2% QNX (Neutrino)



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Please select ALL of the operating systems you are considering using in the <u>next</u> 12 months.



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Operating Systems: Key Takeaways

- Current usage trending toward **open source**, up from 29% in 2010 to 36% in 2014.
- First time open source OSes has outpaced commercial OSes; 38% in 2010 to 33% in 2014.
 - Main reasons are: no need for multitasking, cost and not having to rely on a commercial supplier
- SW engineering staff and their managers are the decision makers on choosing an operating system
- **No switching:** Using the same OS, RTOS or kernel from the previous project occurs at the rate of about 6 out of 10 projects.
- Downward trend in use of **in-house/custom OSes** reflects the five year downward trend seen earlier in the usage of In-house/custom solutions.
- Android is the number one OS under consideration. 5% gain in Free RTOS from 21% in 2013 to 26% in 2014 is a contender for the #1 position for 2015.





Microprocessors



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Who were the greatest influences on the choice of the processor for your current project?



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My current embedded project contains:

A single microprocessor/ microcontroller

2 processors/ microcontrollers

3-5 processors/ microcontrollers

6-10 processors/ microcontrollers

>10 processors/ microcontrollers



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Does your embedded project contain ...



My current embedded project's main processor is a:



My current embedded project's main processor clock rate is:





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



Why did you use the same processor?





What were your reasons for switching processors?

New processor had better features Previous processor too slow New processor had better future growth path Not my choice/processor chosen for me New processor had better SW/dev tools Previous processor no longer available Needed a lower power processor Previous processor too expensive To change operating system Unhappy with previous processor's supplier Other



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Choose a processor from a different family, Choose a different processor from the same architecture, or instruction set family, architecture, or instruction set

■ 2014 (N = 687) ■ 2013 (N = 1088) ■ 2012 (N = 862) ■ 2011 (N = 1003) ■ 2010 (N = 761)

What's most important when choosing a microprocessor?



■ 2014 (N = 1304) ■ 2013 (N = 2034) ■ 2012 (N = 1,662) ■ 2011 (N = 1,859) ■ 2010 (N = 1,501)

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Which vendor that has <u>the best</u> ecosystem for your needs. (Unaided Open End)





What are the most important factors in choosing a processor?

Software development tools available The chip's performance HW development tools available The chip's cost Available middleware, drivers, existing code The operating systems it supports The on-chip I/O or peripherals The chip's power consumption The supplier's reputation Familiarity w/ architecture/chip family Chip family's future growth path The processor's debug support The chip's popularity The chip's security features





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Please select the processor vendors you are familiar with.



Please select the processor <u>vendors</u> you are <u>currently using</u>.



• Added in 2014



Please select the processor <u>vendors</u> you are <u>considering</u> using on your next project. (Top 20)



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Which of the following <u>32-bit</u> chip families would you consider for your <u>next</u> embedded project? (Top 24)



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Which of the following <u>16-bit</u> chip families would you consider for your <u>next</u> embedded project?



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Which of the following <u>8-bit</u> chip families would you consider for your <u>next</u> embedded project?





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Have you upgraded from an 8-bit or 16-bit chip to a 32-bit design in the last 12 months?



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Microprocessors: Key Takeaways

- Whereas software engineers dominate decisions regarding OSes, hardware engineers and their managers dominate decisions regarding the choice of processors.
- The average number of processors/microcontrollers per project is 2.4; half of all projects use just one processor.
- Slow and steady increase of 32-bit chips with the same decline of 8-bit chips.
- **Same processors** are used project to project; the rationale is: maintaining software compatibility and using the same tools achieves efficiency.
- The decision to **switch processors** is driven by **better features (#1)**, speed/performance and future growth.
- The **ecosystem** surrounding the chip itself leads in most important when choosing a microprocessor over the chip itself and the chips supplier/vendor.
- **ARM** is in three of the top 5 positions for 32-bit chip families considered for next embedded project.
- Just under **3** in **10** projects have been ungraded from 8/16-bit chips to 32-bit chips.



FPGAs, Memory, LCDs



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Does your <u>current</u> embedded project contain FPGAs/programmable logic?



Which of the following <u>vendors</u> does your <u>current</u> embedded projects use for FPGAs?





Will your <u>next</u> embedded project likely contain FPGAs/programmable logic?



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Why won't your <u>next</u> project include customizable chips?


If yes, which of the following <u>vendors</u> will you <u>consider</u> in your <u>next</u> embedded project for FPGAs?



For 2014 only -- which of the following vendors does your <u>current embedded projects use</u> for FPGAs, and which <u>will you consider</u> in your next embedded project?



FPGAs, Memory, LCDs: Key Takeaways

- FPGA usage is trending steadily downward from 45% six years ago to 31% last year, rising very slightly this year to 32%. May indicate a bottoming or a pause in the trend downwards.
- There is a gradual decline of FPGAs/programmable logic usage in upcoming embedded projects: 60% said "yes" in 2005, down to 41% in 2014.
- Not needing the functionality, cost and difficulty programming are the main reasons for not using customizable chips/FPGAs.



Hardware IPs, System Level Design & Use of GUIs



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Does your current embedded project reuse hardware or hardware IP from a previous project?



<u>Seven in ten</u> embedded developers **reuse** hardware or hardware IP and have been doing so for the <u>last five years</u>.



Which of the following design techniques will become <u>more</u> <u>important</u> to your designs in the future?





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What system level design tools do you or your organization currently use?



• Added in 2014



Who were the three greatest influencers on the choice of the system-level tools for your current project?

Software engineering staff Software engineering manager Systems engineering staff Hardware engineering staff Corporate management Hardware engineering manager Systems engineering manager Hardware architects Outside influence, customer, stndrds Purchasing manager Marketing manager Other





Which of the following <u>project management</u> software packages do you currently use?





Which of the following <u>Version Control</u> software systems do you currently use?





Does your current design use a graphical user interface?





What type of graphical user interface is it?





Hardware IPs, System Level Design & Use of GUIs: Key Takeaways

- A little more than **7** in **10** respondents **reuse** hardware or hardware IP from previous projects. This reuse pattern has remained stable for 5 years.
- Three of the top four influencers of system-level tools are staff engineers.
- Embedded projects are managed mostly by Microsoft Excel and Microsoft Project.
- Although down a bit, **Subversion** maintains its lead in **version control software**, but Git and CVS gain.



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