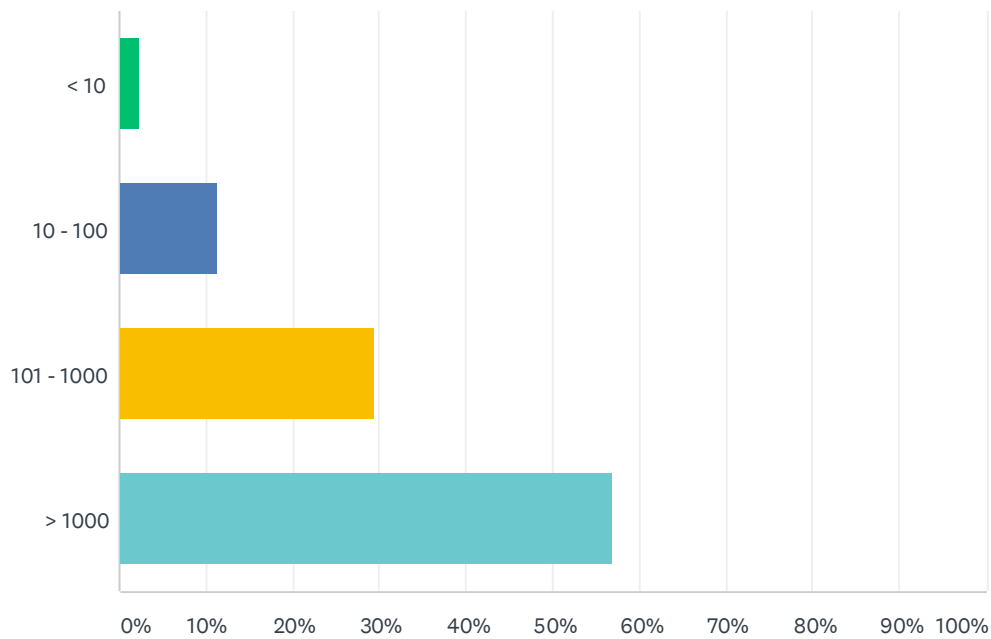


## Q1 How many employees does your organization have?

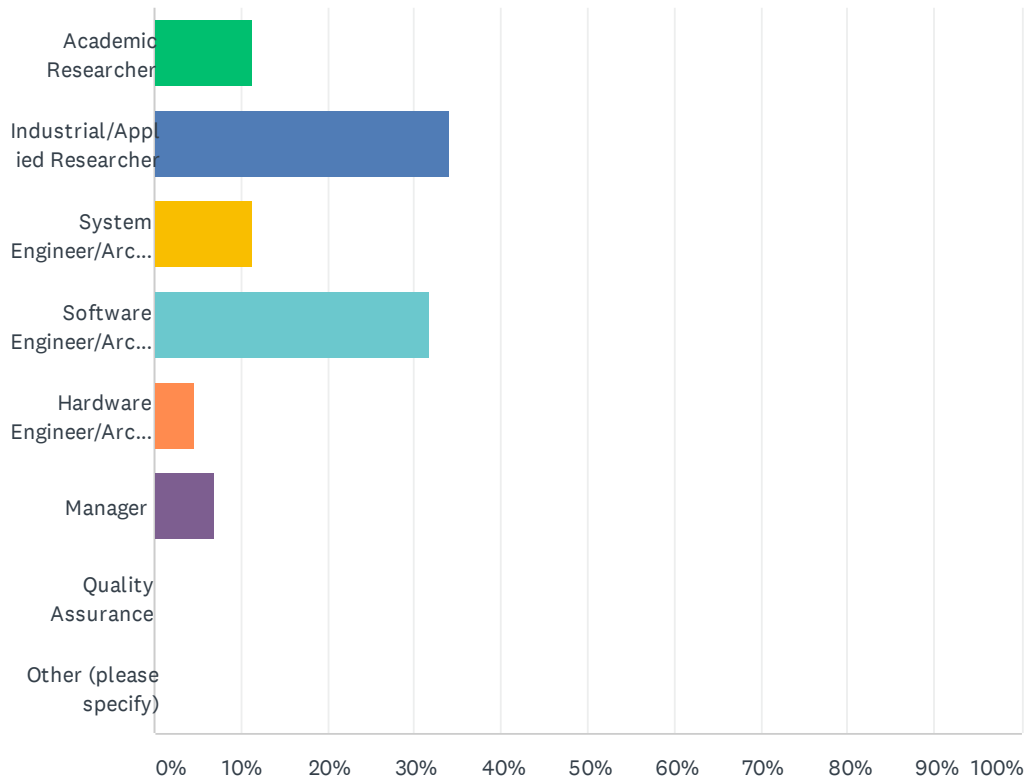
Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
< 10	2.27%	1
10 - 100	11.36%	5
101 - 1000	29.55%	13
> 1000	56.82%	25
TOTAL		44

## Q2 Which position below best describes your current role in your organization?

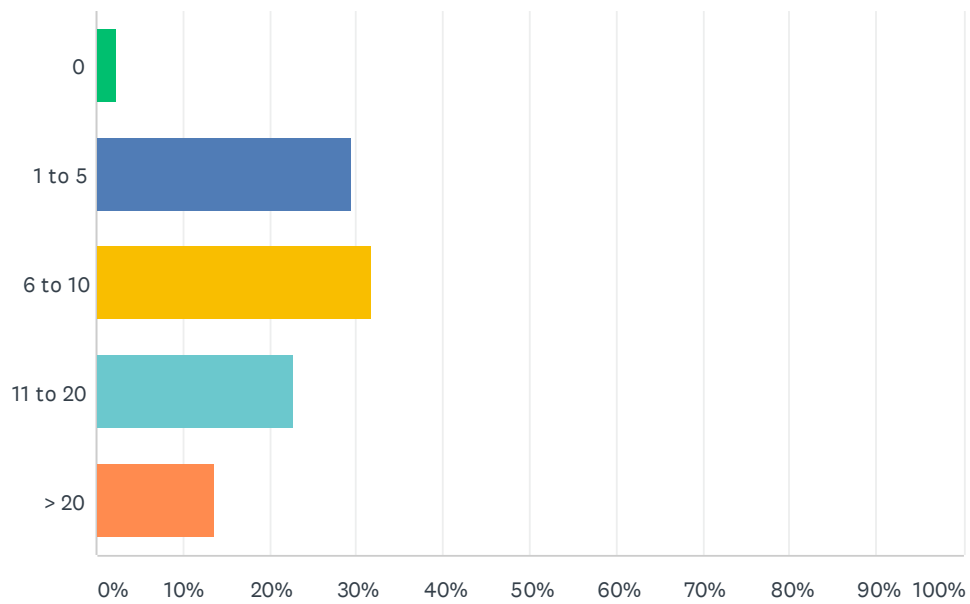
Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
Academic Researcher	11.36%	5
Industrial/Applied Researcher	34.09%	15
System Engineer/Architect	11.36%	5
Software Engineer/Architect	31.82%	14
Hardware Engineer/Architect	4.55%	2
Manager	6.82%	3
Quality Assurance	0.00%	0
Other (please specify)	0.00%	0
<b>TOTAL</b>		<b>44</b>

## Q3 How many years of industrial experience do you have?

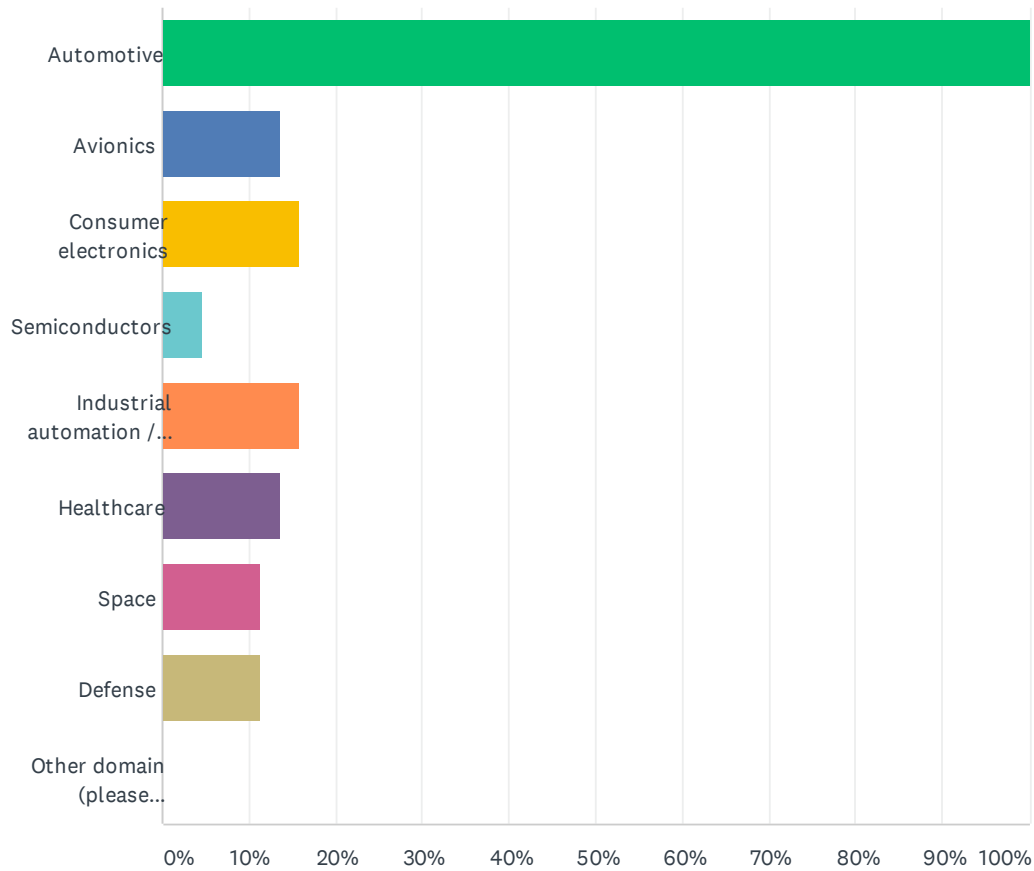
Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
0	2.27%	1
1 to 5	29.55%	13
6 to 10	31.82%	14
11 to 20	22.73%	10
> 20	13.64%	6
TOTAL		44

## Q4 To what domain(s) does the considered system belong? Select all options that apply.

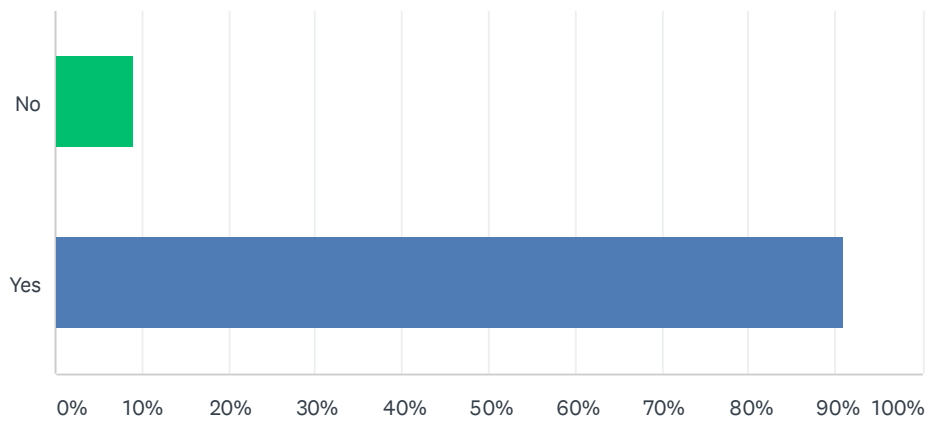
Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
Automotive	100.00%	44
Avionics	13.64%	6
Consumer electronics	15.91%	7
Semiconductors	4.55%	2
Industrial automation / Manufacturing	15.91%	7
Healthcare	13.64%	6
Space	11.36%	5
Defense	11.36%	5
Other domain (please specify)	0.00%	0
Total Respondents: 44		

## Q5 Is (parts of) the considered system safety-critical?

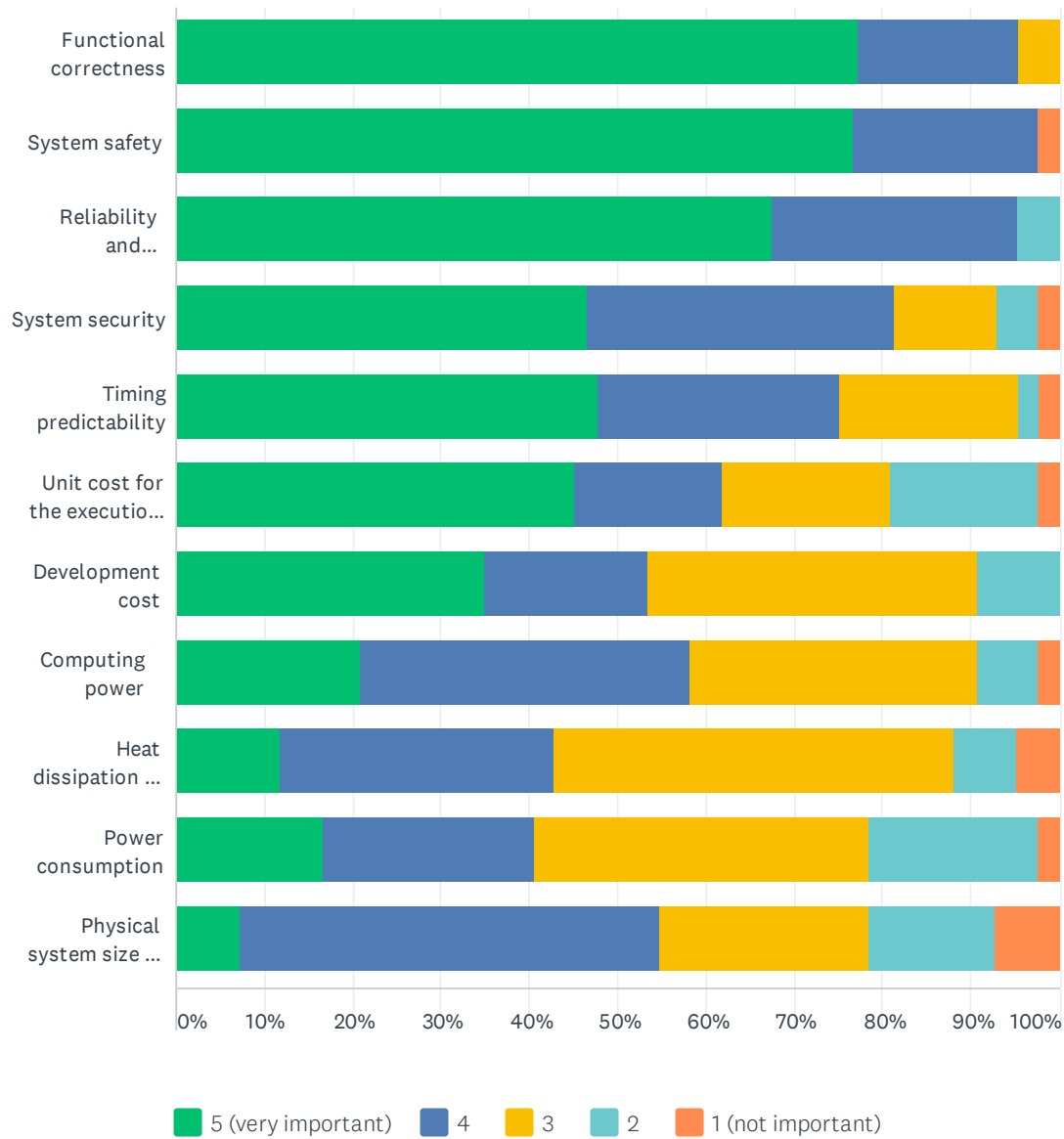
Answered: 44 Skipped: 0



ANSWER CHOICES	RESPONSES	
No	9.09%	4
Yes	90.91%	40
TOTAL		44

## Q6 Give a score to the importance of different system aspects for the considered system.

Answered: 44 Skipped: 0

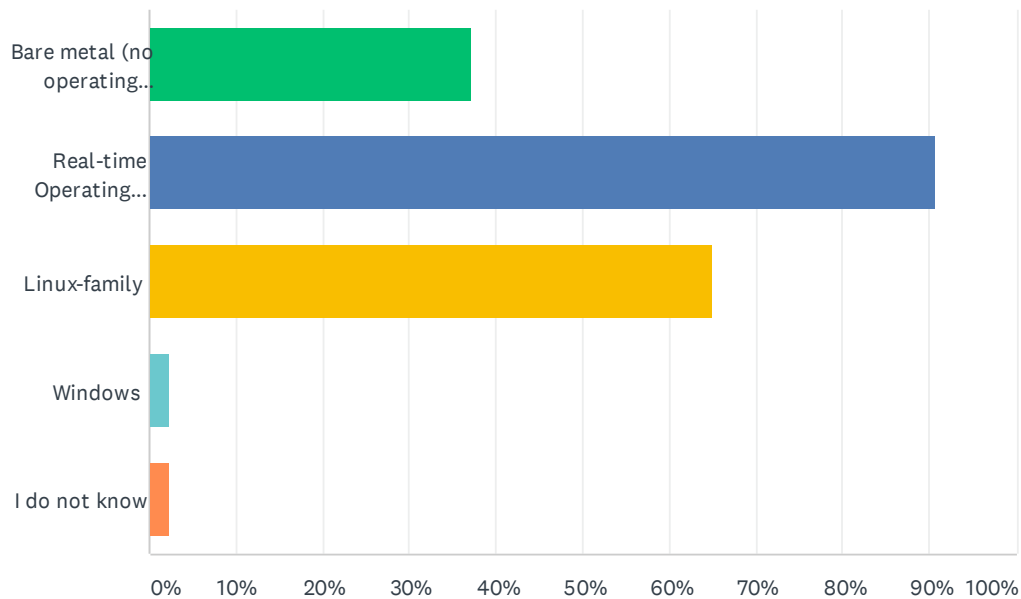


# Real-time Systems Survey

	5 (VERY IMPORTANT)	4	3	2	1 (NOT IMPORTANT)	TOTAL	WEIGHTED AVERAGE
Functional correctness	77.27% 34	18.18% 8	4.55% 2	0.00% 0	0.00% 0	44	4.73
System safety	76.74% 33	20.93% 9	0.00% 0	0.00% 0	2.33% 1	43	4.70
Reliability and availability	67.44% 29	27.91% 12	0.00% 0	4.65% 2	0.00% 0	43	4.58
System security	46.51% 20	34.88% 15	11.63% 5	4.65% 2	2.33% 1	43	4.19
Timing predictability	47.73% 21	27.27% 12	20.45% 9	2.27% 1	2.27% 1	44	4.16
Unit cost for the execution platform	45.24% 19	16.67% 7	19.05% 8	16.67% 7	2.38% 1	42	3.86
Development cost	34.88% 15	18.60% 8	37.21% 16	9.30% 4	0.00% 0	43	3.79
Computing power	20.93% 9	37.21% 16	32.56% 14	6.98% 3	2.33% 1	43	3.67
Heat dissipation / thermal constraints	11.90% 5	30.95% 13	45.24% 19	7.14% 3	4.76% 2	42	3.38
Power consumption	16.67% 7	23.81% 10	38.10% 16	19.05% 8	2.38% 1	42	3.33
Physical system size / weight	7.14% 3	47.62% 20	23.81% 10	14.29% 6	7.14% 3	42	3.33

## Q7 What operating systems are running on the considered system? Select all options that apply.

Answered: 43 Skipped: 1

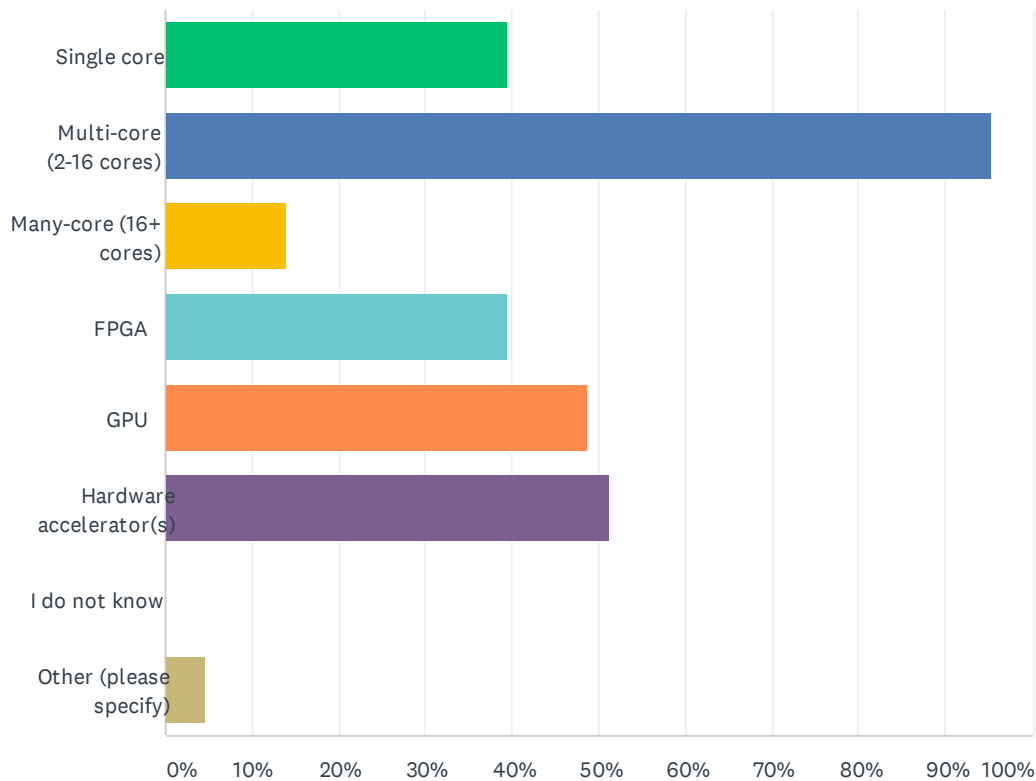


ANSWER CHOICES	RESPONSES	
Bare metal (no operating system)	37.21%	16
Real-time Operating System, Micro kernel, or libraries	90.70%	39
Linux-family	65.12%	28
Windows	2.33%	1
I do not know	2.33%	1
Total Respondents: 43		



## Q8 Please select the options that describe the processing hardware of the considered system. Select all options that apply.

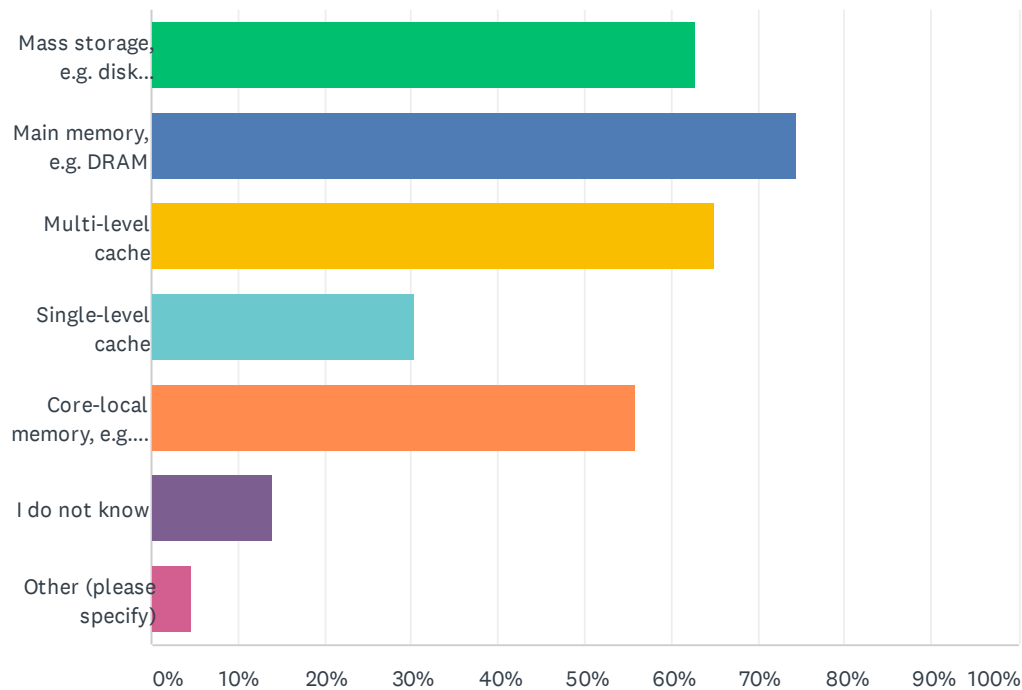
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
Single core	39.53%	17
Multi-core (2-16 cores)	95.35%	41
Many-core (16+ cores)	13.95%	6
FPGA	39.53%	17
GPU	48.84%	21
Hardware accelerator(s)	51.16%	22
I do not know	0.00%	0
Other (please specify)	4.65%	2
Total Respondents: 43		

## Q9 Please select the options that describe the memory hierarchy of the considered system. Select all options that apply.

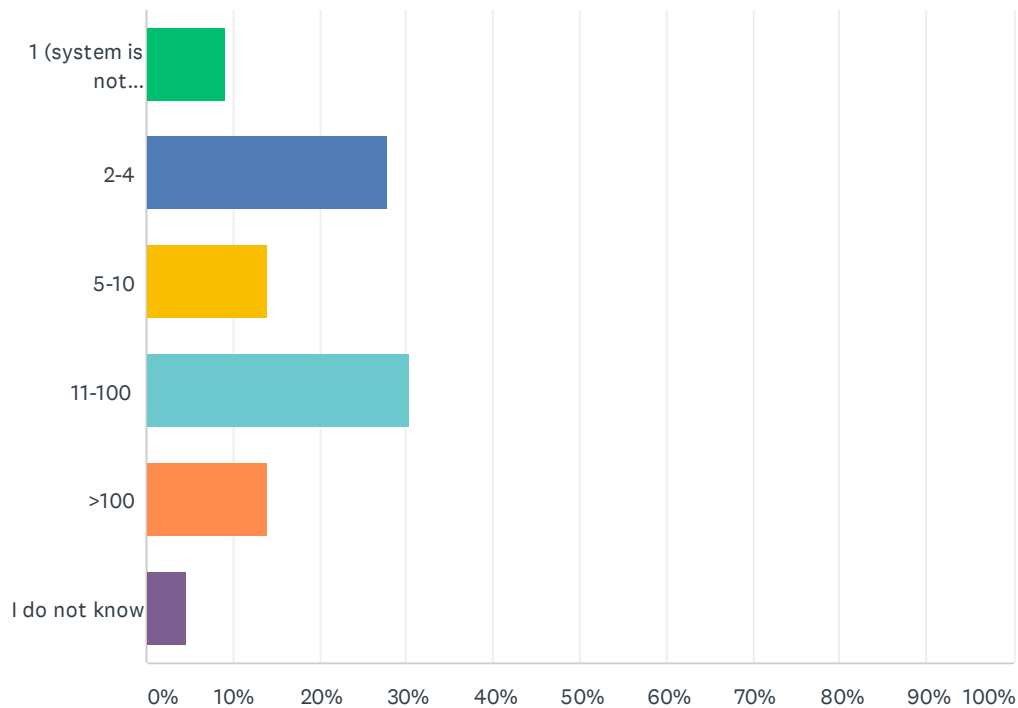
Answered: 43   Skipped: 1



ANSWER CHOICES	RESPONSES	
Mass storage, e.g. disk drive, flash	62.79%	27
Main memory, e.g. DRAM	74.42%	32
Multi-level cache	65.12%	28
Single-level cache	30.23%	13
Core-local memory, e.g. SRAM/BRAM scratchpad(s)	55.81%	24
I do not know	13.95%	6
Other (please specify)	4.65%	2
Total Respondents: 43		

## Q10 How many distributed nodes (e.g. ECUs) are there in the considered system?

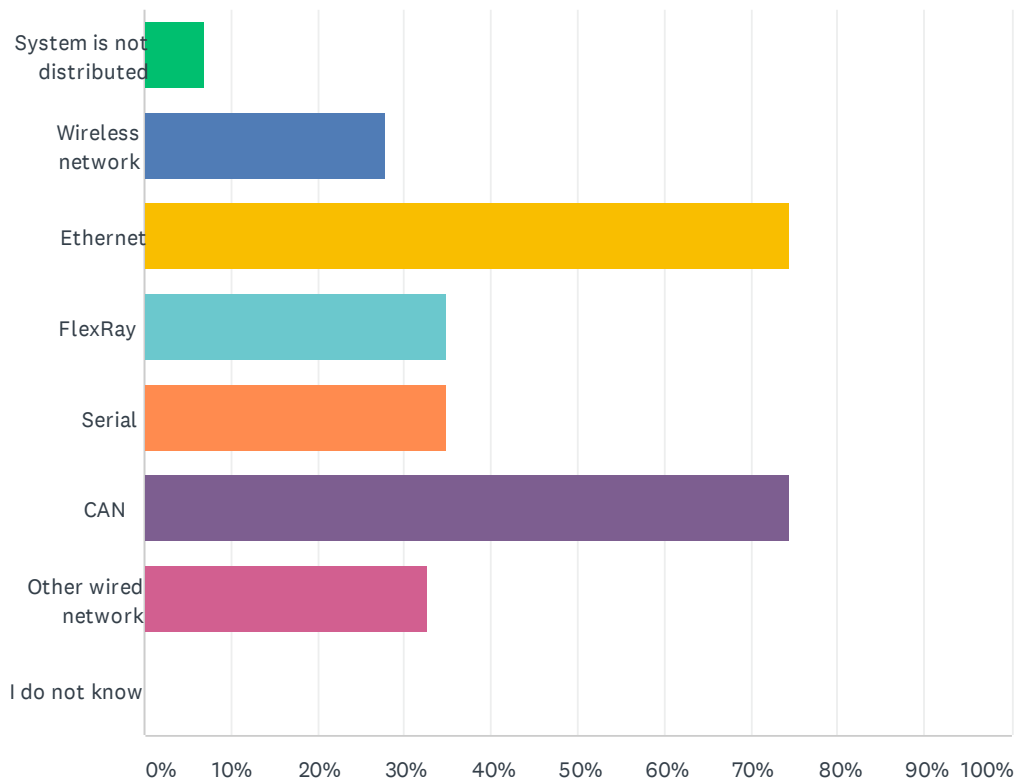
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
1 (system is not distributed)	9.30%	4
2-4	27.91%	12
5-10	13.95%	6
11-100	30.23%	13
>100	13.95%	6
I do not know	4.65%	2
TOTAL		43

## Q11 Which of the following options describe the connectivity between the nodes within the (distributed) system? Select all options that apply.

Answered: 43 Skipped: 1

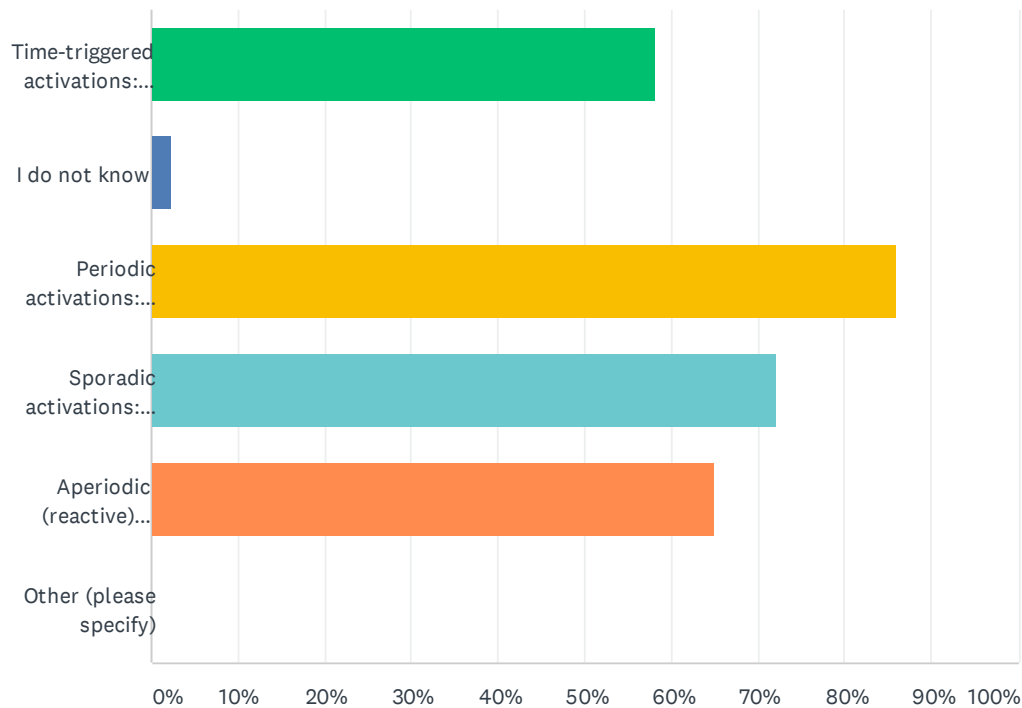


ANSWER CHOICES	RESPONSES	
System is not distributed (1)	6.98%	3
Wireless network (2)	27.91%	12
Ethernet (3)	74.42%	32
FlexRay (4)	34.88%	15
Serial (5)	34.88%	15
CAN (6)	74.42%	32
Other wired network (7)	32.56%	14
I do not know (8)	0.00%	0
Total Respondents: 43		

BASIC STATISTICS				
Minimum	Maximum	Median	Mean	Standard Deviation
1.00	7.00	4.00	4.46	1.69

## Q12 Which of the following sentences are true about task activations in your system? Select all options that apply.

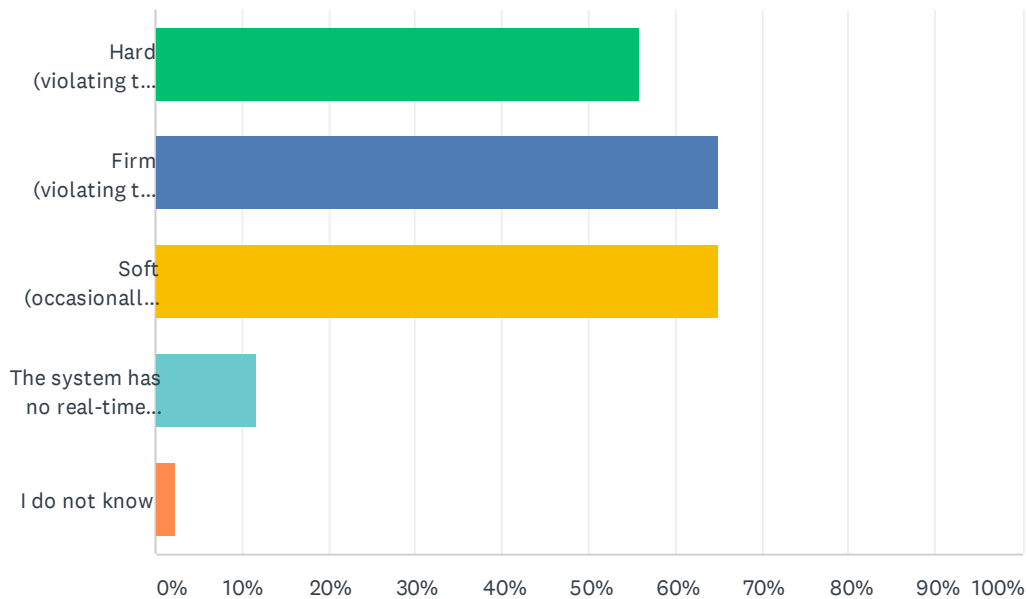
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
Time-triggered activations: Functionalities are activated at certain time instants according to a predefined time table.	58.14%	25
I do not know	2.33%	1
Periodic activations: Functionalities are activated periodically (e.g., using a timer interrupt)	86.05%	37
Sporadic activations: Functionalities may be activated at any time. However, every two activations are separated at least by a certain time interval	72.09%	31
Aperiodic (reactive) activations: Functionalities may be activated by internal or external events that may happen at any time (non-deterministic).	65.12%	28
Other (please specify)	0.00%	0
Total Respondents: 43		

### Q13 Which of the following types of timing constraints exist(s) in the considered system? Select all options that apply.

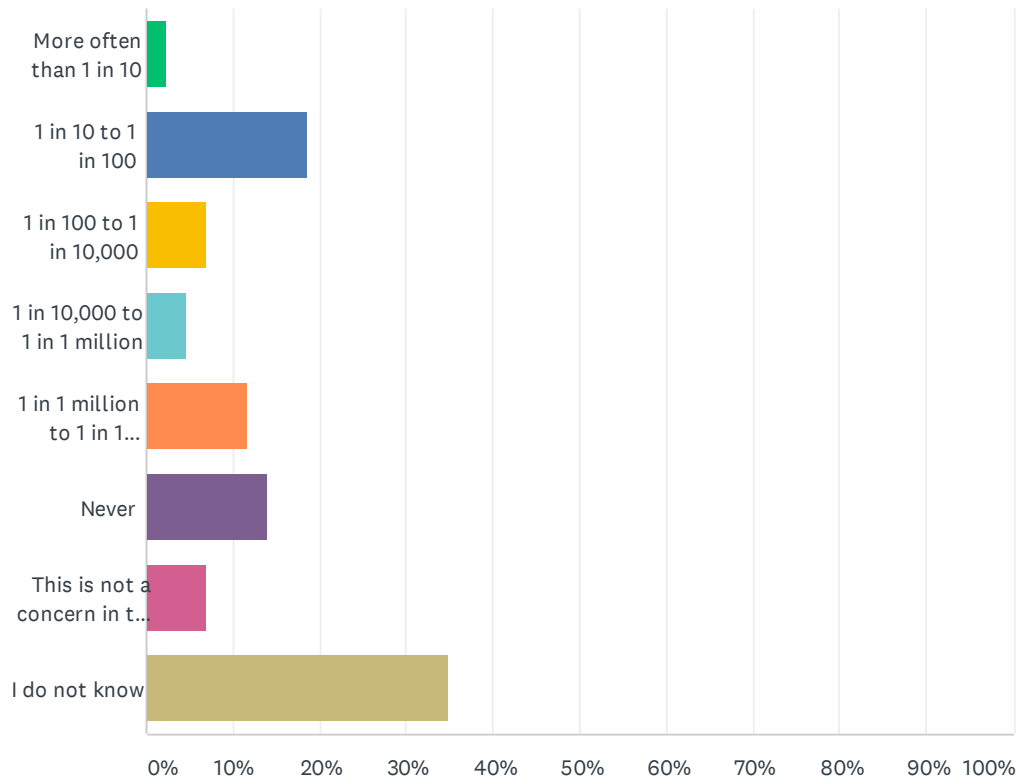
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
Hard (violating the timing constraint is considered a failure of the system)	55.81%	24
Firm (violating the timing constraint is highly undesirable)	65.12%	28
Soft (occasionally violating the timing constraint is acceptable, but it negatively impacts the perceived quality of the system)	65.12%	28
The system has no real-time constraints	11.63%	5
I do not know	2.33%	1
Total Respondents: 43		

## Q14 For the most time-critical functions in the considered system, roughly how frequently can the deadline of a function be missed without causing a system failure?

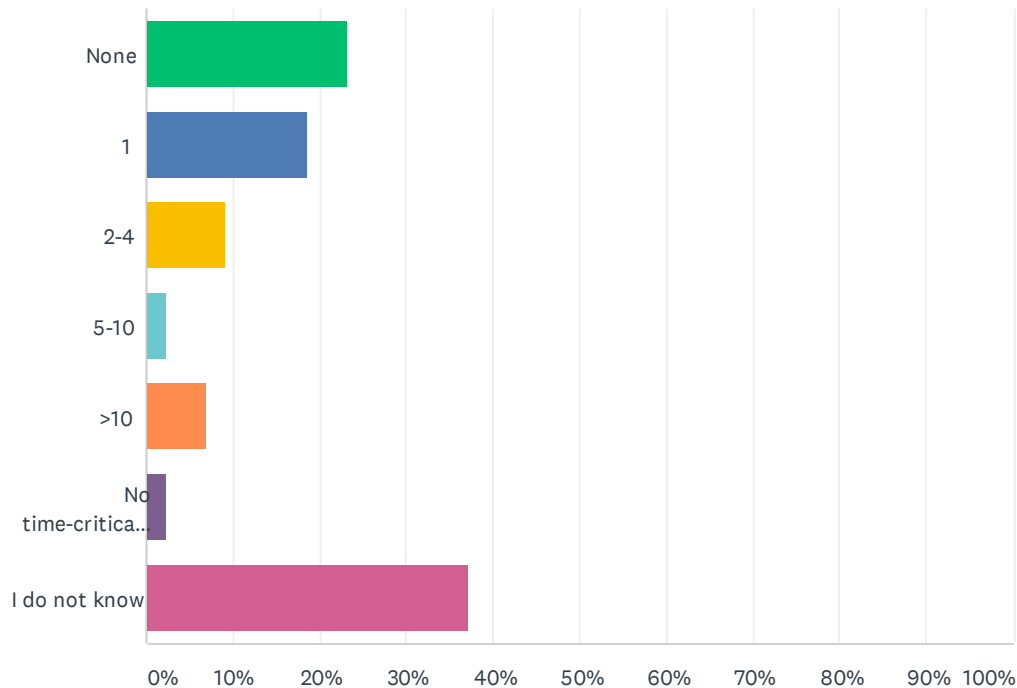
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
More often than 1 in 10	2.33%	1
1 in 10 to 1 in 100	18.60%	8
1 in 100 to 1 in 10,000	6.98%	3
1 in 10,000 to 1 in 1 million	4.65%	2
1 in 1 million to 1 in 1 billion	11.63%	5
Never	13.95%	6
This is not a concern in the system	6.98%	3
I do not know	34.88%	15
TOTAL		43

**Q15 What is the largest number of consecutive deadline misses that could be tolerated by the most time-critical functions in the system, assuming that such a blackout does not reoccur for a very long time?**

Answered: 43 Skipped: 1

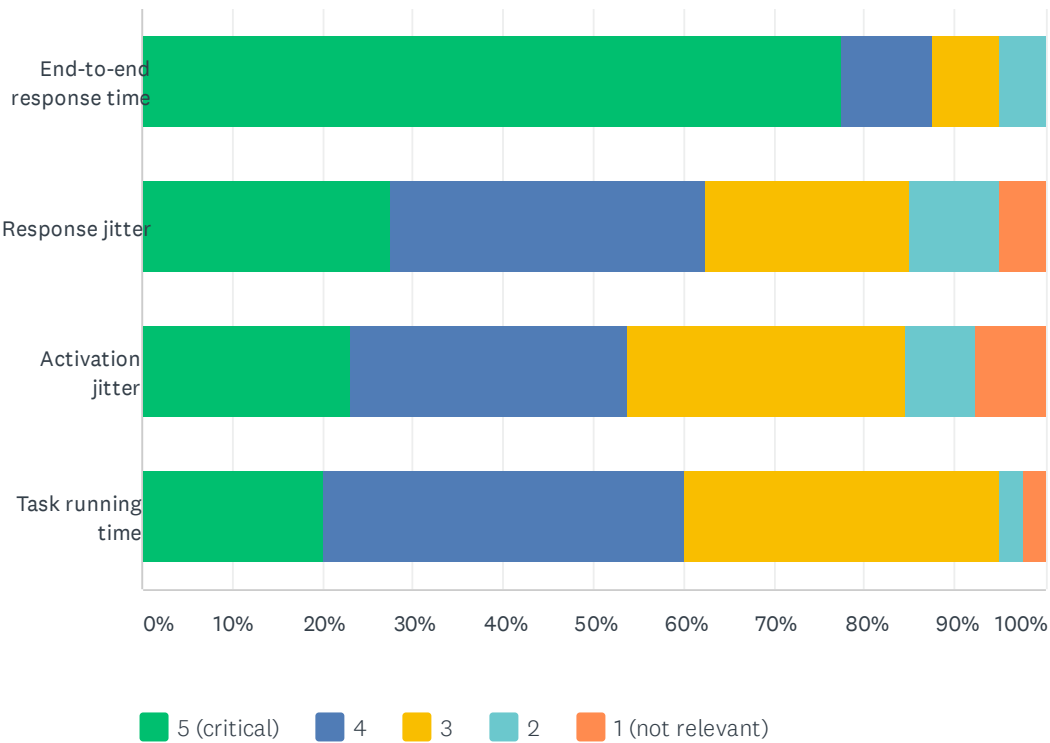


ANSWER CHOICES	RESPONSES	
None	23.26%	10
1	18.60%	8
2-4	9.30%	4
5-10	2.33%	1
>10	6.98%	3
No time-critical functionality present	2.33%	1
I do not know	37.21%	16
<b>TOTAL</b>		<b>43</b>



## Q16 What are relevant timing constraints in the considered system?

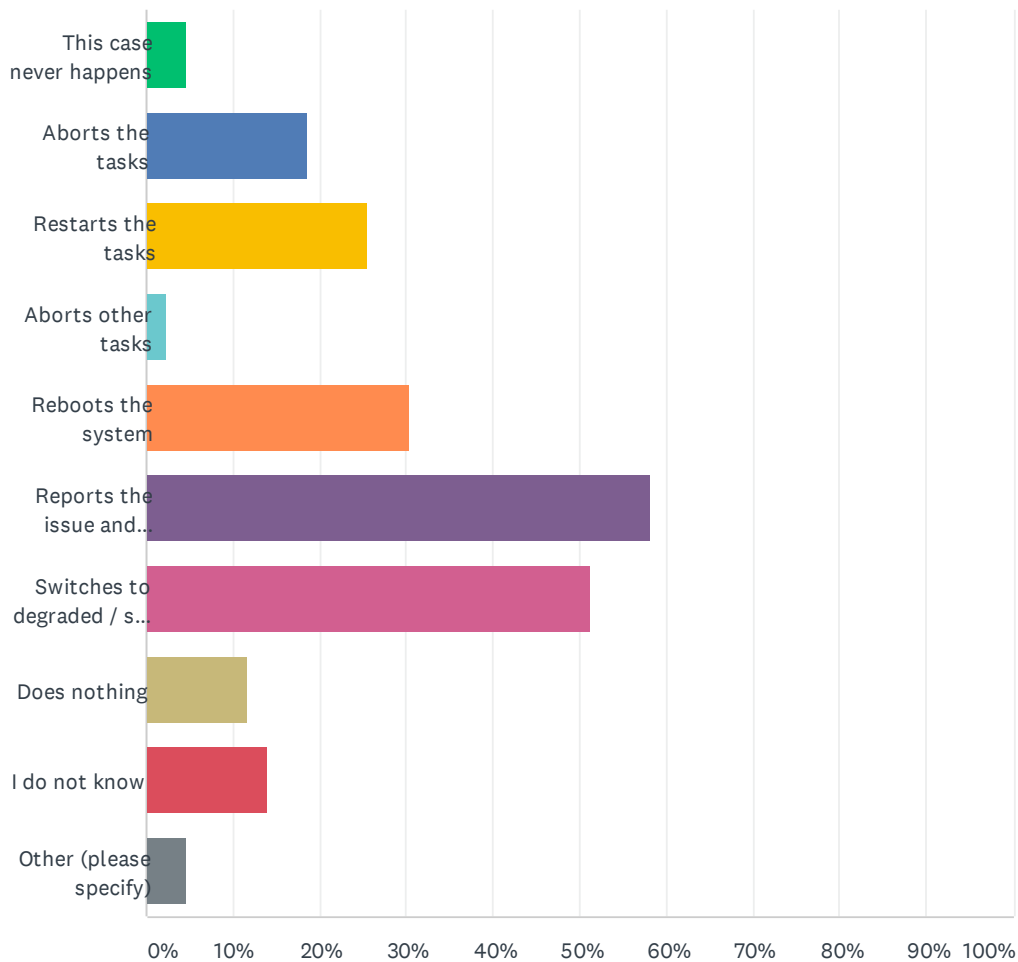
Answered: 42 Skipped: 2



	5 (CRITICAL)	4	3	2	1 (NOT RELEVANT)	TOTAL	WEIGHTED AVERAGE
End-to-end response time	77.50% 31	10.00% 4	7.50% 3	5.00% 2	0.00% 0	40	4.60
Response jitter	27.50% 11	35.00% 14	22.50% 9	10.00% 4	5.00% 2	40	3.70
Activation jitter	23.08% 9	30.77% 12	30.77% 12	7.69% 3	7.69% 3	39	3.54
Task running time	20.00% 8	40.00% 16	35.00% 14	2.50% 1	2.50% 1	40	3.73

## Q17 How does the considered system react if tasks miss deadlines? Select all options that apply.

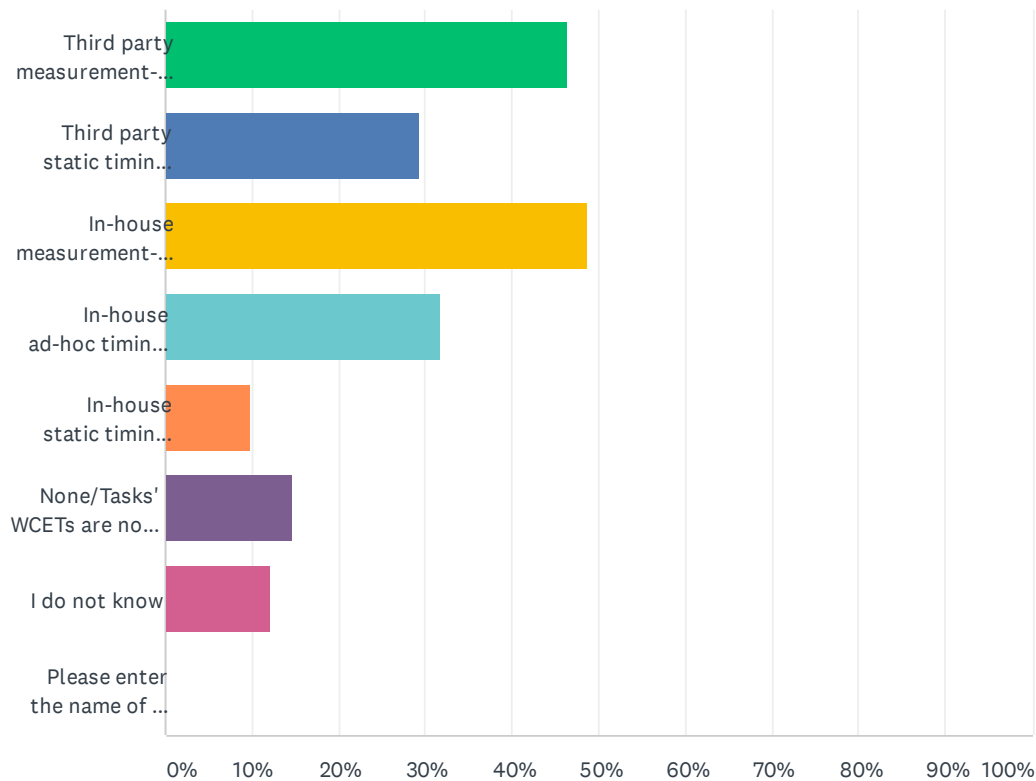
Answered: 43 Skipped: 1



ANSWER CHOICES	RESPONSES	
This case never happens	4.65%	2
Aborts the tasks	18.60%	8
Restarts the tasks	25.58%	11
Aborts other tasks	2.33%	1
Reboots the system	30.23%	13
Reports the issue and continues	58.14%	25
Switches to degraded / safe mode	51.16%	22
Does nothing	11.63%	5
I do not know	13.95%	6
Other (please specify)	4.65%	2
Total Respondents: 43		

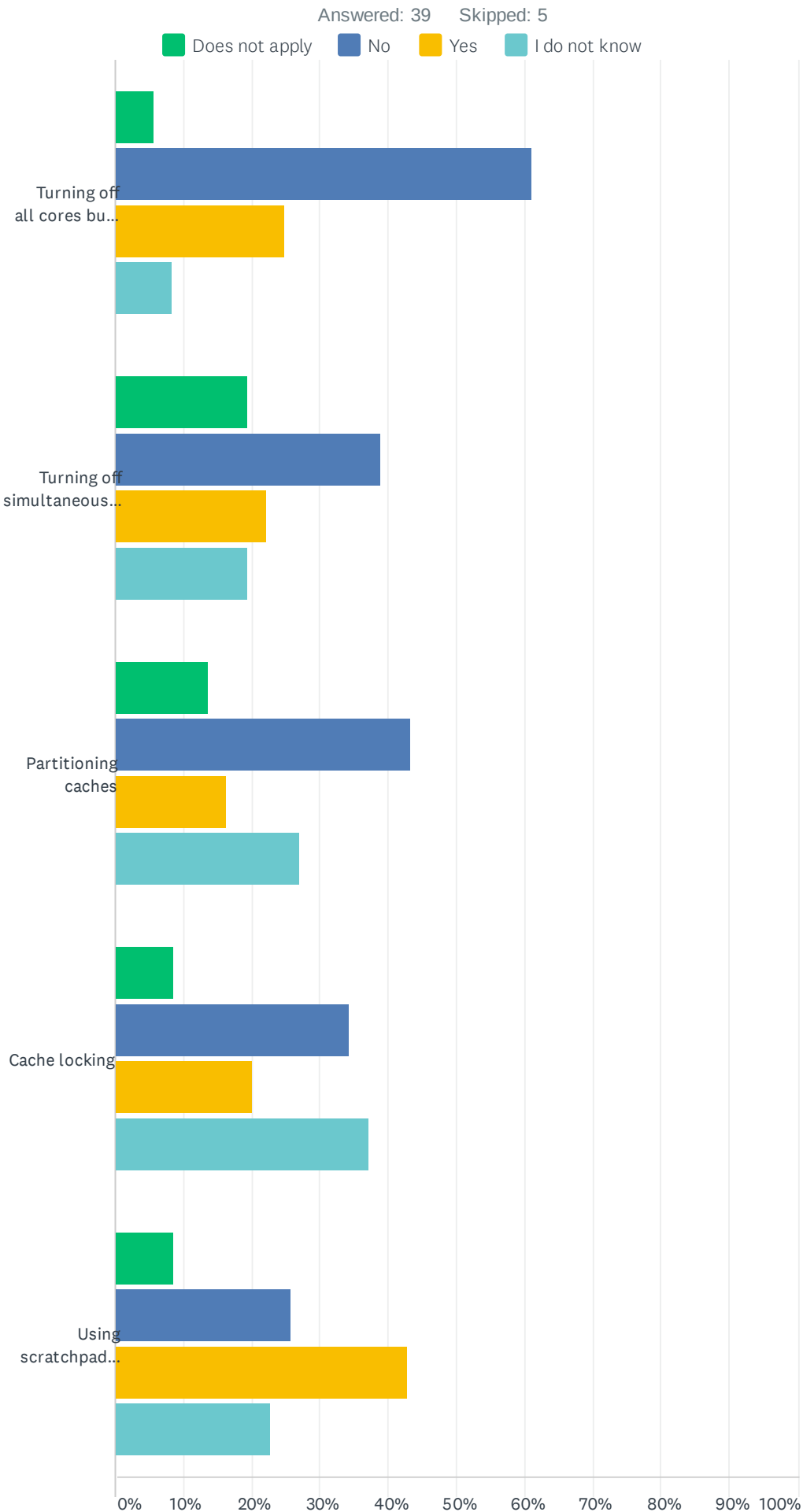
## Q18 Which methods are used for Worst-Case Execution Time (WCET) estimation in the considered system? Select all options that apply.

Answered: 41 Skipped: 3

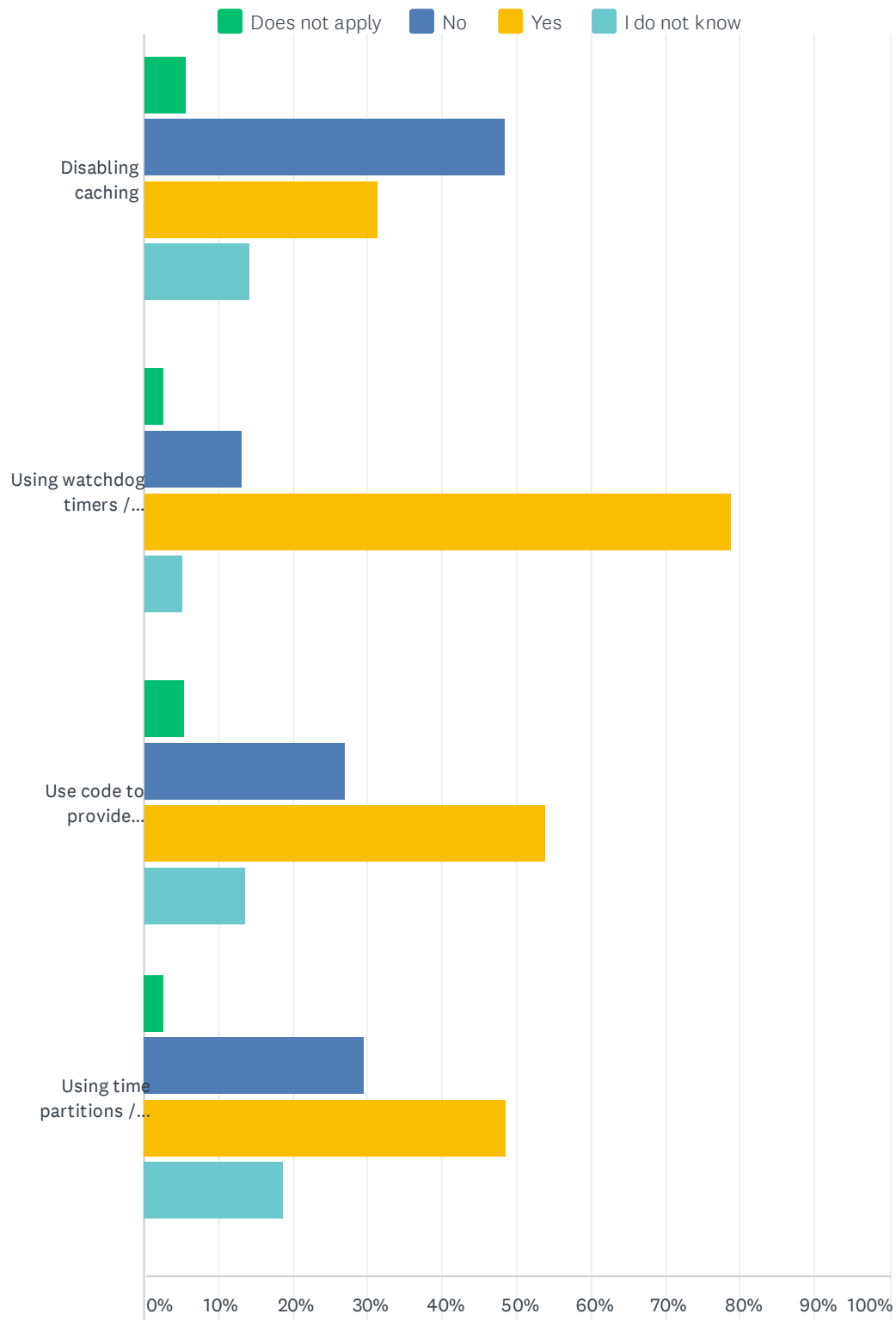


ANSWER CHOICES	RESPONSES	
Third party measurement-based timing analysis tool	46.34%	19
Third party static timing analysis tools	29.27%	12
In-house measurement-based timing analysis tool	48.78%	20
In-house ad-hoc timing measurements	31.71%	13
In-house static timing analysis tool	9.76%	4
None/Tasks' WCETs are not estimated	14.63%	6
I do not know	12.20%	5
Please enter the name of the used WCET estimation tool, if any	0.00%	0
Total Respondents: 41		

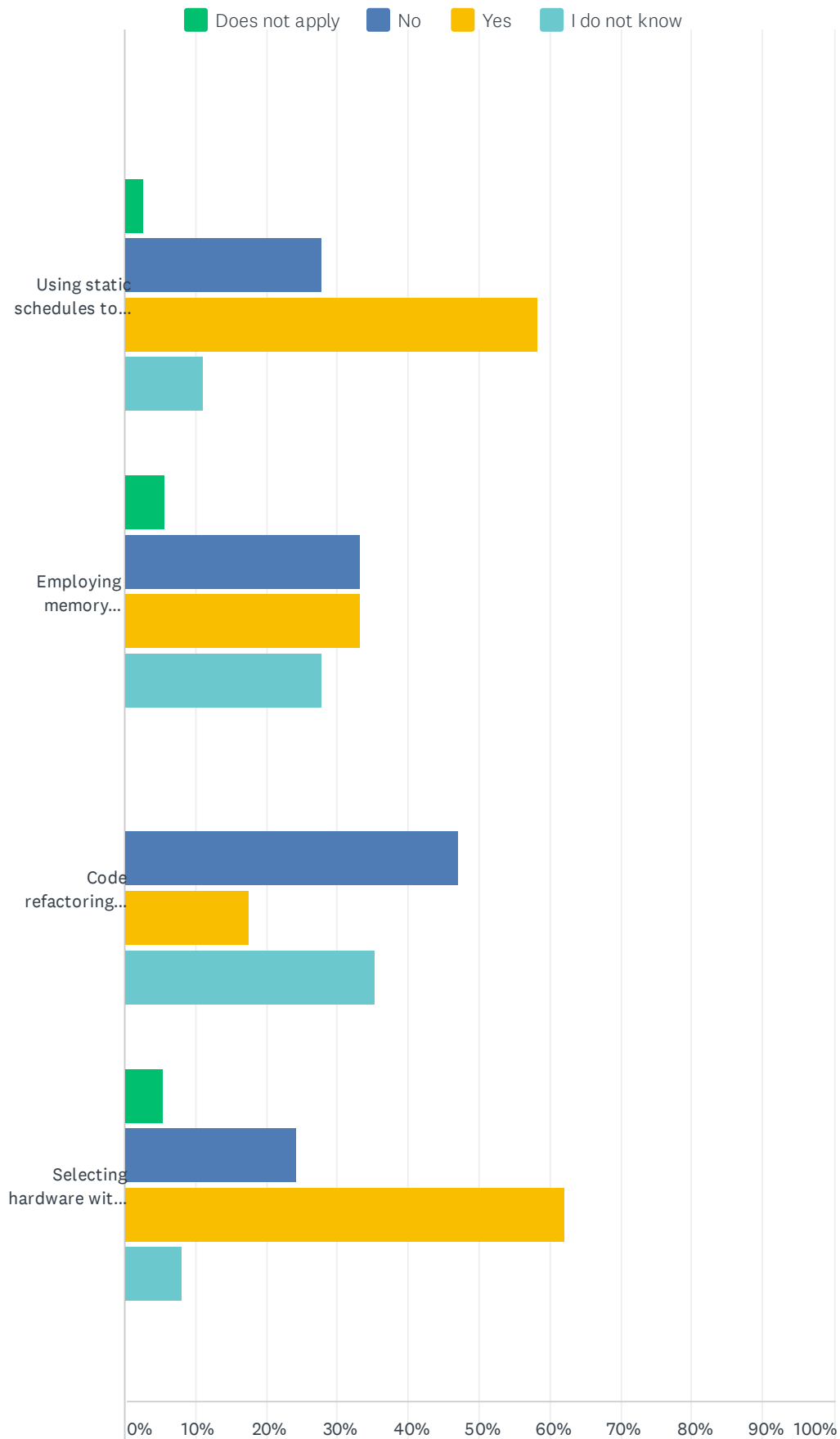
## Q19 What steps are taken to help increase timing predictability?



## Real-time Systems Survey



## Real-time Systems Survey

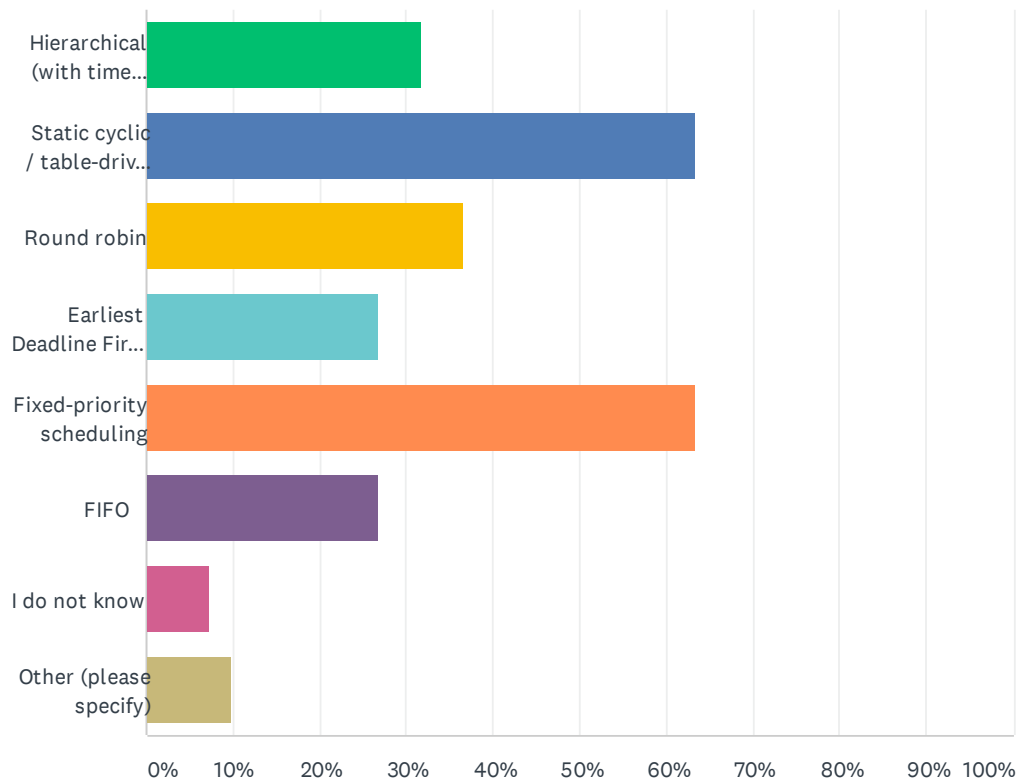


# Real-time Systems Survey

	DOES NOT APPLY	NO	YES	I DO NOT KNOW	TOTAL
Turning off all cores but one	5.56% 2	61.11% 22	25.00% 9	8.33% 3	36
Turning off simultaneous multi-threading (e.g. Hyperthreading)	19.44% 7	38.89% 14	22.22% 8	19.44% 7	36
Partitioning caches	13.51% 5	43.24% 16	16.22% 6	27.03% 10	37
Cache locking	8.57% 3	34.29% 12	20.00% 7	37.14% 13	35
Using scratchpad memory instead of caches	8.57% 3	25.71% 9	42.86% 15	22.86% 8	35
Disabling caching	5.71% 2	48.57% 17	31.43% 11	14.29% 5	35
Using watchdog timers / runtime monitors	2.63% 1	13.16% 5	78.95% 30	5.26% 2	38
Use code to provide degraded, but usable, outputs in the event of overruns	5.41% 2	27.03% 10	54.05% 20	13.51% 5	37
Using time partitions / reservations / servers	2.70% 1	29.73% 11	48.65% 18	18.92% 7	37
Using static schedules to control execution	2.78% 1	27.78% 10	58.33% 21	11.11% 4	36
Employing memory bandwidth regulation	5.56% 2	33.33% 12	33.33% 12	27.78% 10	36
Code refactoring into separate memory access phases and computation phases	0.00% 0	47.06% 16	17.65% 6	35.29% 12	34
Selecting hardware with better time-predictability	5.41% 2	24.32% 9	62.16% 23	8.11% 3	37

## Q20 Which task scheduling policy/policies are used in the considered system? Select all options that apply.

Answered: 41   Skipped: 3

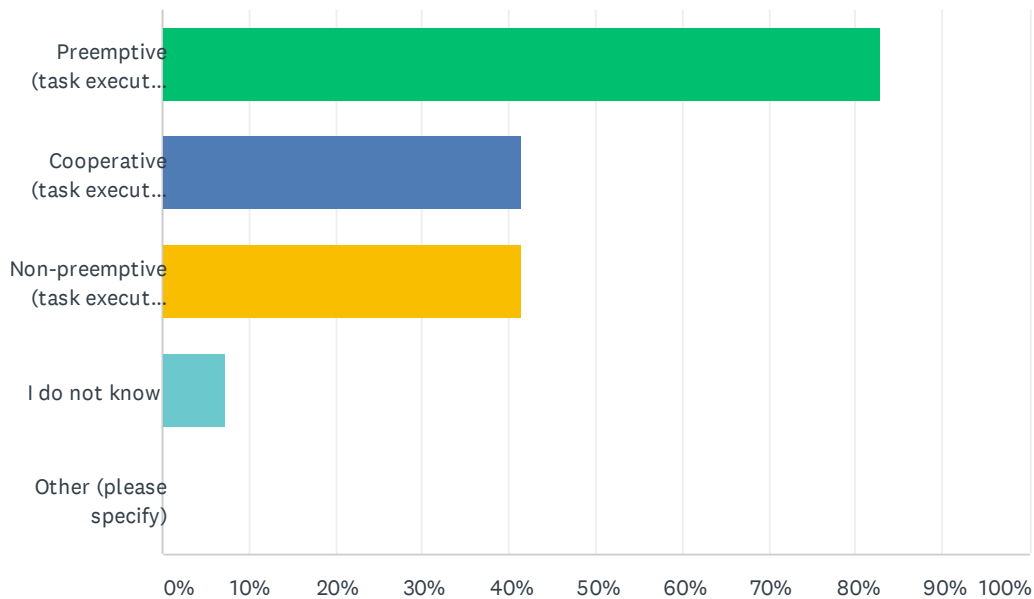


ANSWER CHOICES	RESPONSES	
Hierarchical (with time partitions or reservations)	31.71%	13
Static cyclic / table-driven / time-triggered scheduling	63.41%	26
Round robin	36.59%	15
Earliest Deadline First (EDF)	26.83%	11
Fixed-priority scheduling	63.41%	26
FIFO	26.83%	11
I do not know	7.32%	3
Other (please specify)	9.76%	4
Total Respondents: 41		



## Q21 Please indicate the types of preemption that are supported in the considered system. Select all options that apply.

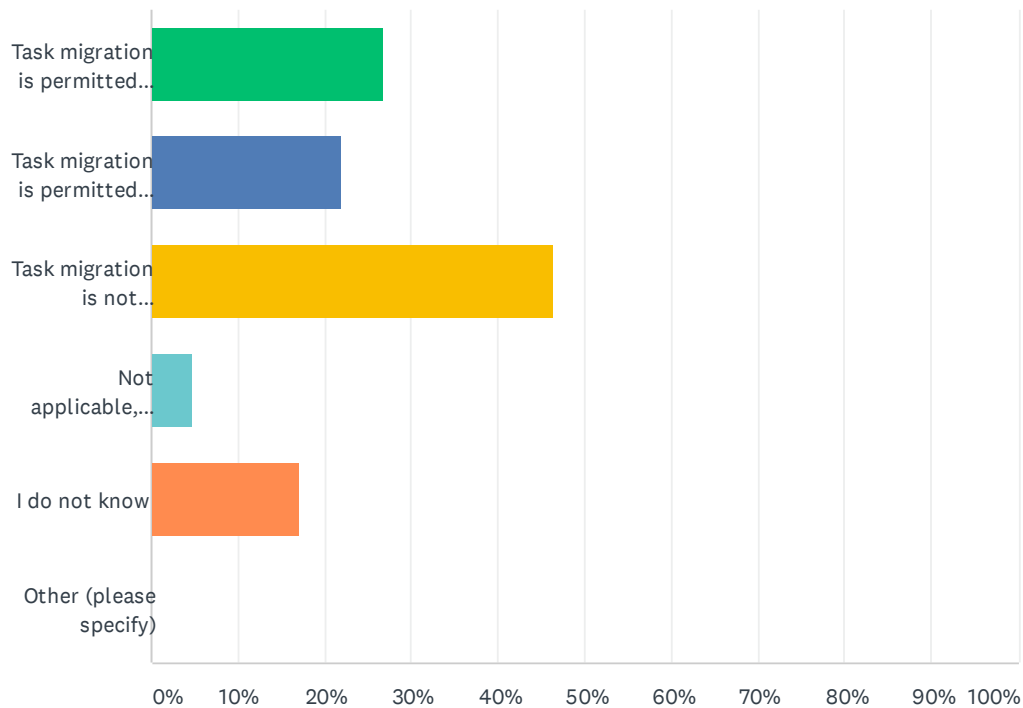
Answered: 41   Skipped: 3



ANSWER CHOICES	RESPONSES	
Preemptive (task execution can be preempted by other tasks at any time)	82.93%	34
Cooperative (task execution can be preempted by other tasks, but only at predefined preemption points)	41.46%	17
Non-preemptive (task execution cannot be preempted by other tasks before completion)	41.46%	17
I do not know	7.32%	3
Other (please specify)	0.00%	0
Total Respondents: 41		

## Q22 Please indicate how task migration can take place between different cores in the considered system. Select all options that apply.

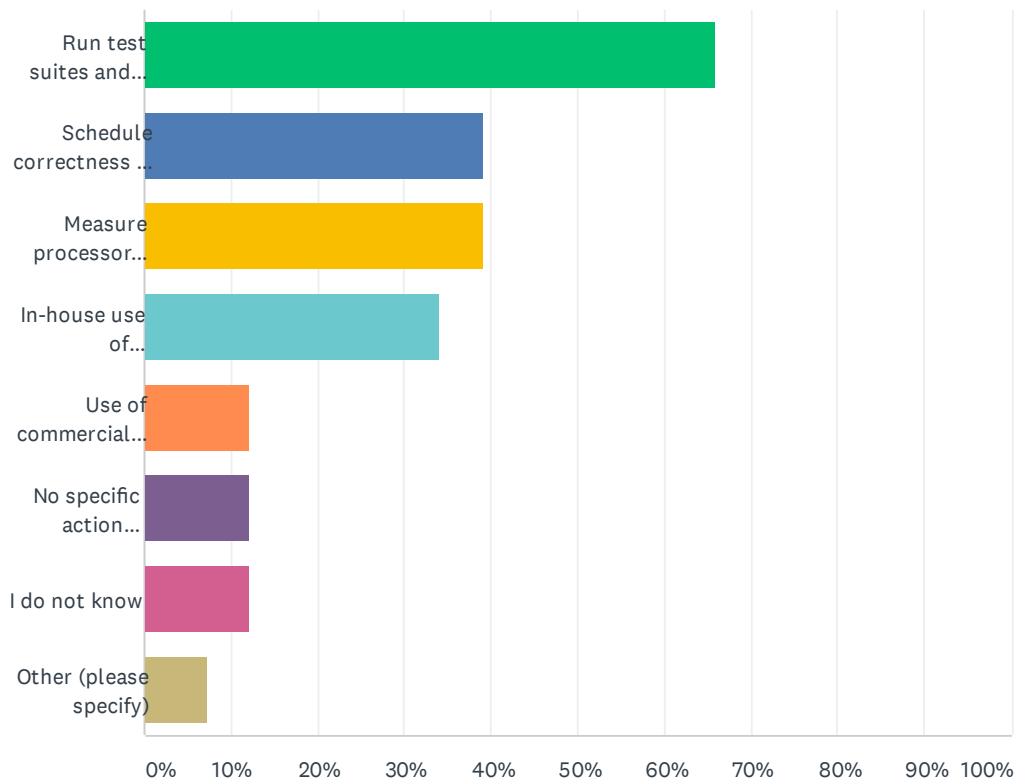
Answered: 41 Skipped: 3



ANSWER CHOICES	RESPONSES	
Task migration is permitted while the task is executing	26.83%	11
Task migration is permitted between two invocations of the function	21.95%	9
Task migration is not permitted	46.34%	19
Not applicable, single core system	4.88%	2
I do not know	17.07%	7
Other (please specify)	0.00%	0
Total Respondents: 41		

## Q23 How do you ensure that the functions in the considered system respect their deadlines? Select all options that apply.

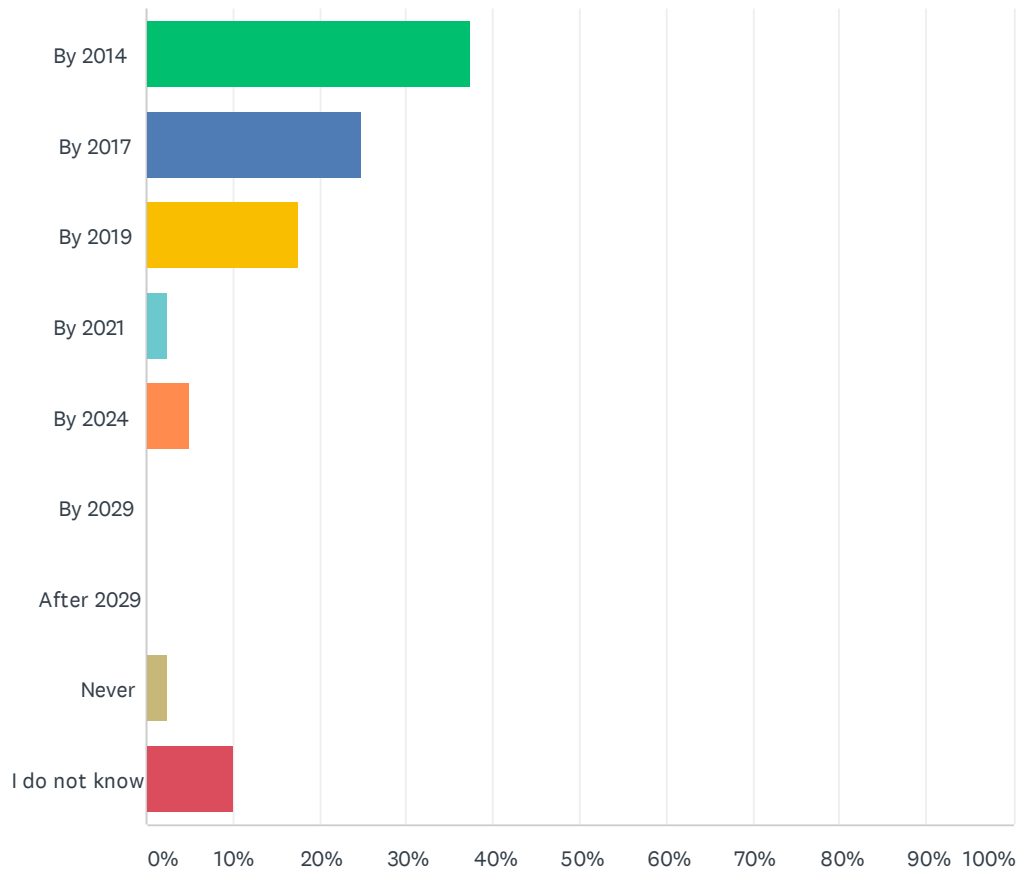
Answered: 41 Skipped: 3



ANSWER CHOICES	RESPONSES	
Run test suites and check for any overruns	65.85%	27
Schedule correctness is by construction. With a static schedule, provided execution time budgets hold for each software component / task, no deadlines will be missed.	39.02%	16
Measure processor utilization and ensure it is always below a predefined threshold, e.g. 50%	39.02%	16
In-house use of schedulability analysis	34.15%	14
Use of commercial schedulability analysis tools	12.20%	5
No specific action undertaken	12.20%	5
I do not know	12.20%	5
Other (please specify)	7.32%	3
Total Respondents: 41		

## Q24 By which year did or do you expect development projects for real-time embedded systems in your department to begin using multi-core embedded processors (i.e. processors with 2 to 16 cores)?

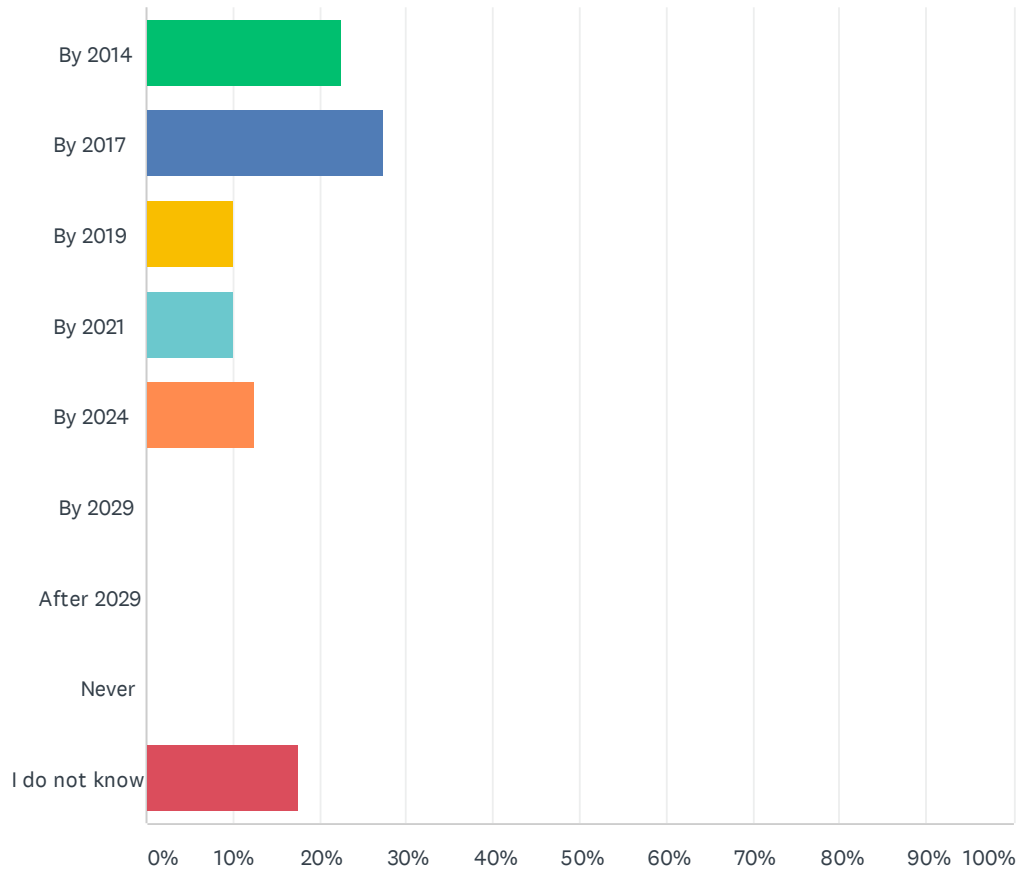
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
By 2014	37.50%	15
By 2017	25.00%	10
By 2019	17.50%	7
By 2021	2.50%	1
By 2024	5.00%	2
By 2029	0.00%	0
After 2029	0.00%	0
Never	2.50%	1
I do not know	10.00%	4
<b>TOTAL</b>		<b>40</b>

## Q25 By which year did or do you expect development projects for real-time embedded systems in your department to begin using heterogeneous multi-cores with different types of CPUs, GPUs, and other accelerators?

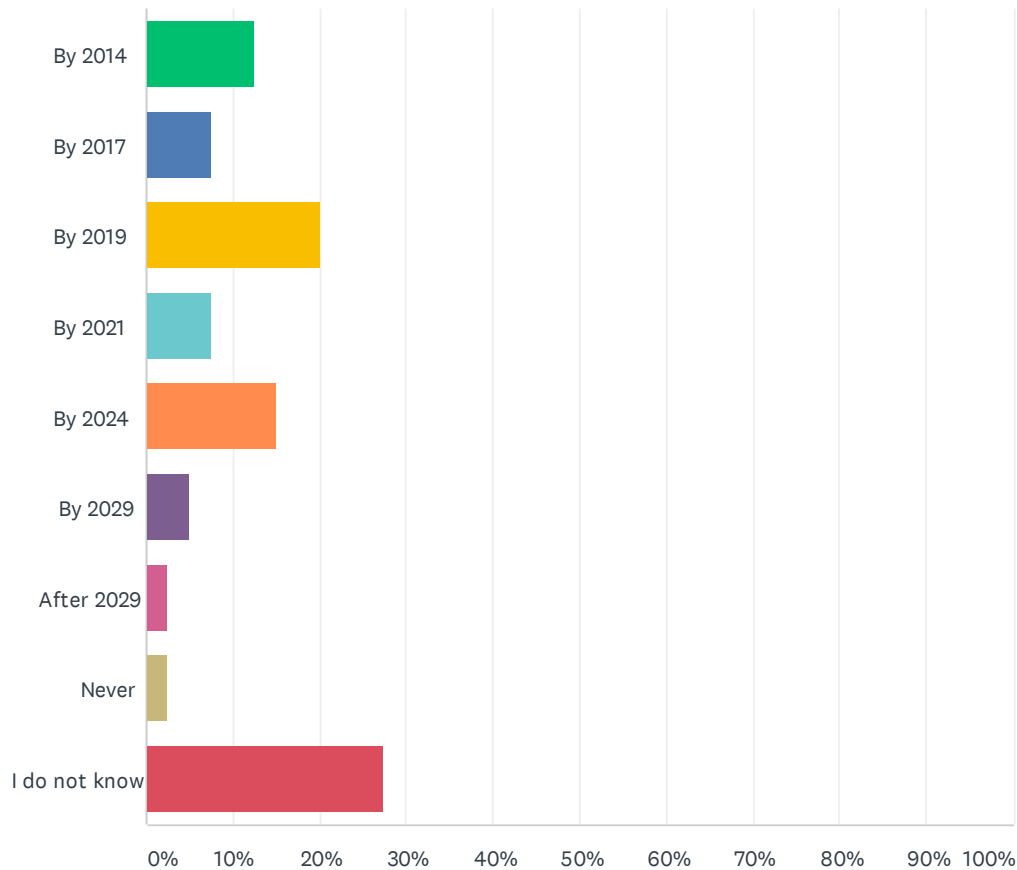
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
By 2014	22.50%	9
By 2017	27.50%	11
By 2019	10.00%	4
By 2021	10.00%	4
By 2024	12.50%	5
By 2029	0.00%	0
After 2029	0.00%	0
Never	0.00%	0
I do not know	17.50%	7
<b>TOTAL</b>		<b>40</b>

## Q26 By which year did or do you expect development projects for real-time embedded systems in your department to begin using many-core embedded processors (i.e. processors with more than 16 cores)?

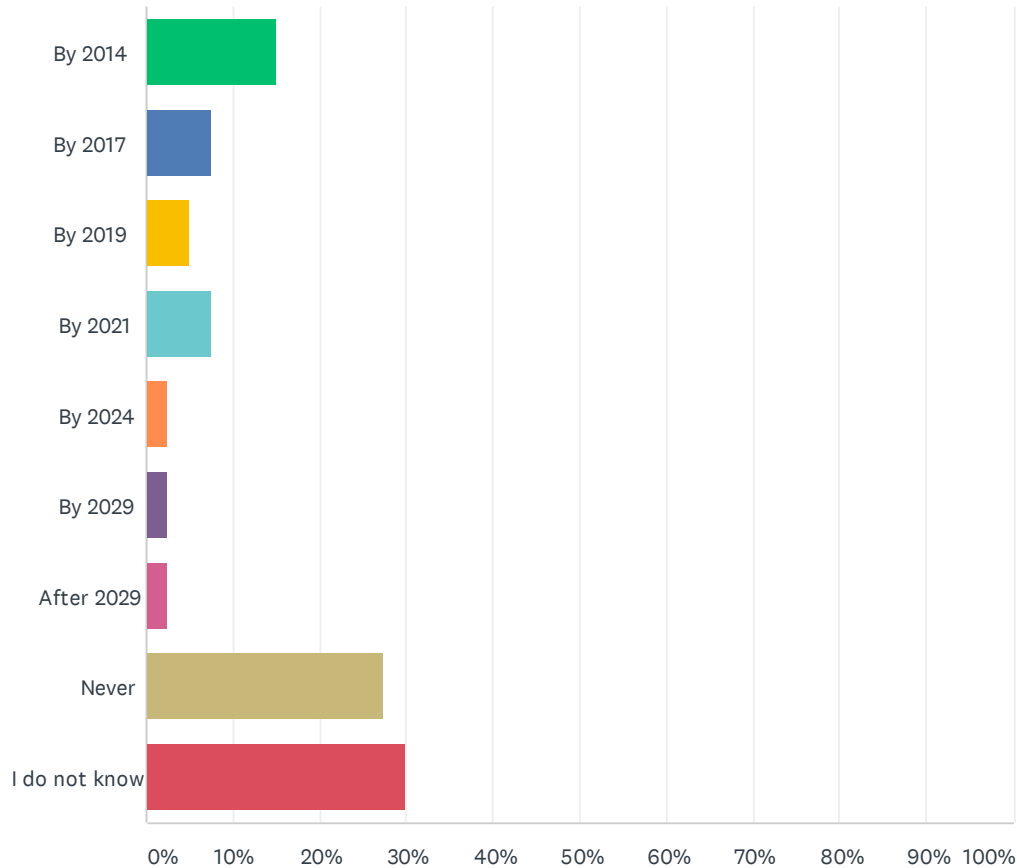
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
By 2014	12.50%	5
By 2017	7.50%	3
By 2019	20.00%	8
By 2021	7.50%	3
By 2024	15.00%	6
By 2029	5.00%	2
After 2029	2.50%	1
Never	2.50%	1
I do not know	27.50%	11
<b>TOTAL</b>		<b>40</b>

## Q27 By which year did or do you expect development projects for real-time embedded systems in your department to stop using single-core embedded processors (i.e. processors with 1 core)?

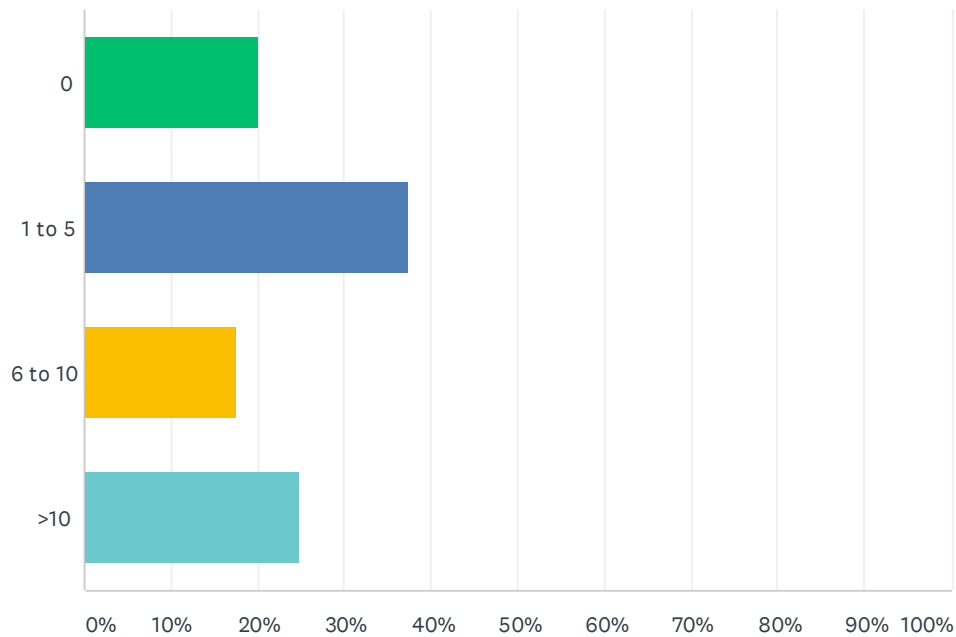
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
By 2014	15.00%	6
By 2017	7.50%	3
By 2019	5.00%	2
By 2021	7.50%	3
By 2024	2.50%	1
By 2029	2.50%	1
After 2029	2.50%	1
Never	27.50%	11
I do not know	30.00%	12
TOTAL		40

## Q28 How many research publications (e.g. conference or journal papers) in the real-time systems field have you read in the last year?

Answered: 40 Skipped: 4

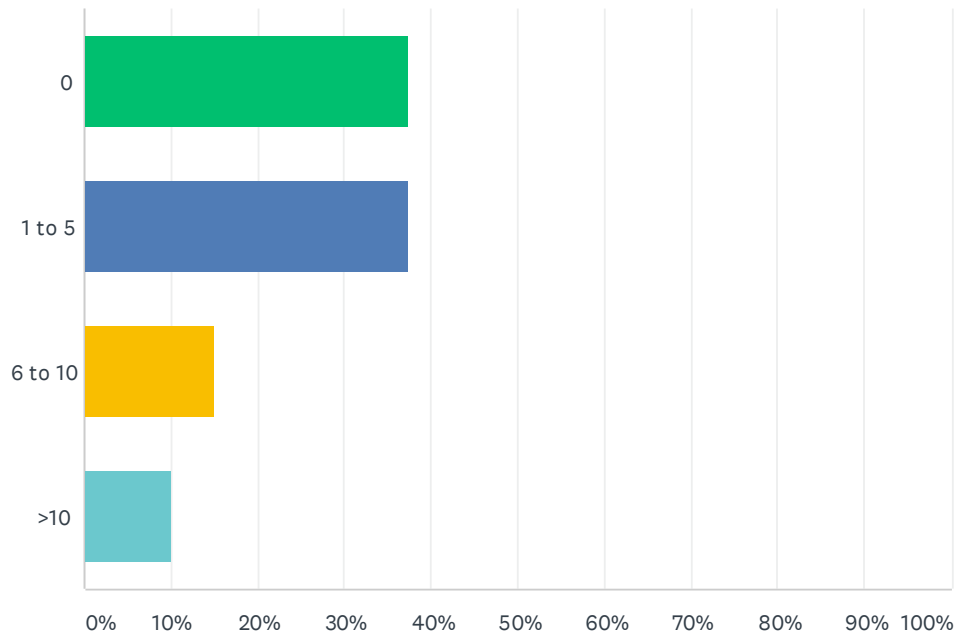


ANSWER CHOICES	RESPONSES	
0	20.00%	8
1 to 5	37.50%	15
6 to 10	17.50%	7
>10	25.00%	10
TOTAL		40



**Q29 How many real-time systems research publications (e.g. conference or journal papers) have you published as a (co-)author in the last 5 years?**

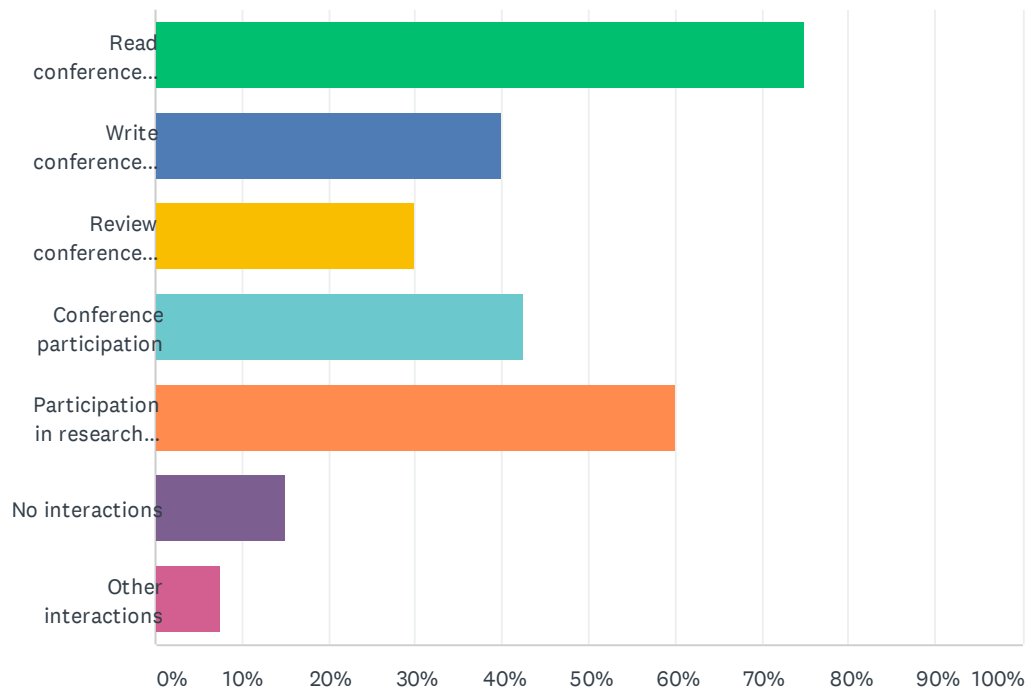
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
0	37.50%	15
1 to 5	37.50%	15
6 to 10	15.00%	6
>10	10.00%	4
TOTAL		40

## Q30 How do you interact with the real-time research community? Select all options that apply.

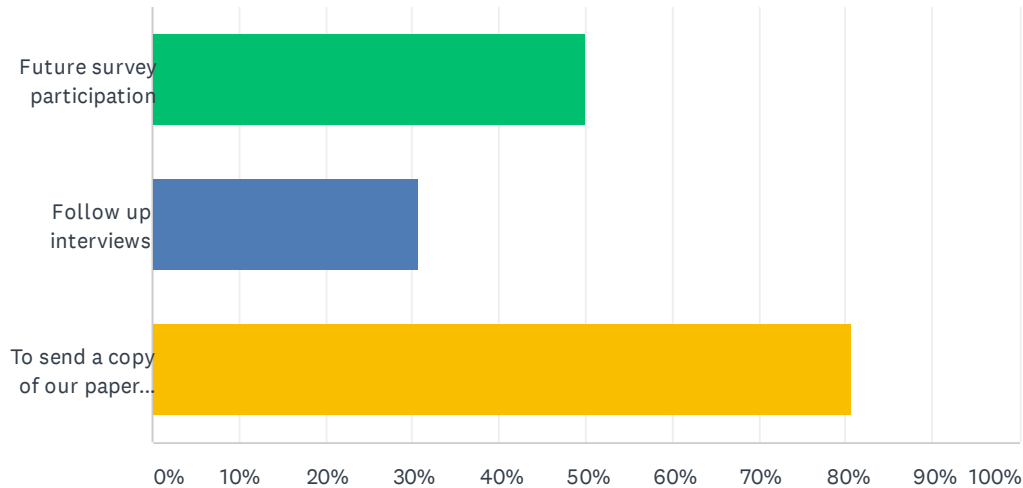
Answered: 40 Skipped: 4



ANSWER CHOICES	RESPONSES	
Read conference papers and journal articles	75.00%	30
Write conference papers and journal articles	40.00%	16
Review conference papers and journal articles	30.00%	12
Conference participation	42.50%	17
Participation in research projects with academics	60.00%	24
No interactions	15.00%	6
Other interactions	7.50%	3
Total Respondents: 40		

Q31 Please indicate the purposes for which we may contact you again, if any. If we may contact you again, but you do not want your e-mail address to identify your responses in the survey, you can instead e-mail your preferences to [benny.akesson@tno.nl](mailto:benny.akesson@tno.nl) . We will not share or use your e-mail for any other purposes.

Answered: 26 Skipped: 18



ANSWER CHOICES	RESPONSES	
Future survey participation	50.00%	13
Follow up interviews	30.77%	8
To send a copy of our paper when it is published	80.77%	21
Total Respondents: 26		

Q32 Please enter any feedback or remarks on this survey.

Answered: 10   Skipped: 34