

2. Electronics field

2.1. Overview

Electronics is foundation technology that will support the future technological society. In FY 2020–25, it is expected to still be a core industry for Japan's economic and industrial competitiveness. Technology develops extremely fast, however, and because development competition, including price competition, is extremely harsh on a global scale, technological innovation and discernment of markets is vital. Both bottom-up approach and top-down approach, that is to say, both basic technologies and applications, play important roles.

For the notable technology areas in the electronics field as well, each area was selected with a view to its bottom-up device technology or top-down application. Integrated systems, silicon electronics, optical and photonic devices, wireless electronics, bioelectronics, and molecular and organic electronics belong to the former, while storage, displays, energy conversion/storage devices, digital home appliances, ubiquitous electronics, robot electronics, car electronics, network electronics, and security electronics belong to the latter.

The electronics field develops consistently associated with the development of other fields. The electronics field is an exit for the nanotechnology and materials and manufacturing fields, while the information and communications, life science, and environment fields are exits for electronics. The same conditions are expected to prevail 25 years from now as well.

This chapter discusses the outlook of notable technology areas in the electronics field, which plays a core role in science and technology in this way. Below, I provide a brief overview especially of those notable science and technology areas that are basic bottom-up technologies.

In the integrated systems area, new integrated systems related to silicon VLSI will not become the mainstream for at least 20 years. Therefore, in order to achieve higher-performance integrated systems and provide various new applications to society, silicon VLSI research and development should be emphasized over the coming 10 to 20 years. In silicon electronics, greater speed, storage, and performance and smaller size will further develop, with new materials, logic, and manufacturing methods using optical wiring expected as future technologies.

The optical and photonic devices area will have three major trends. First is the pioneering of new wavelength bands in the deep ultraviolet region with terahertz bandwidths. Second is the expected creation of technologies to innovate the photonics networks that are already a basic technology of the Information Society in terms of capacity and quality. Third, related to such photonic networks, is the development of innovative optical-function devices to move conventional signal processing including optical-electronic conversion towards full-optical signal processing technology such as photonic crystals and optical-buffer memory.

In the wireless electronics area, low-power, low-loss, and high energy-density devices will become more important. For example, for portable software wireless devices that can handle different transmission methods, device-level power reduction such as high-speed A/D conversion and large-scale signal processing is essential, so further development including design and modes is necessary.

The bioelectronics area has three aspects. First is the application of electronics and electronics-derived technologies to biological and chemical technologies to create sensors, measuring systems, and medical devices. Second are methods to address the high-performance electronics of organisms by integrating cells and biological molecules with electronic devices. Third is proof of the

existence of bottom-up nanotechnology through proposals for research utilizing two-dimensional crystals formed from proteins and assembling structures based on the arrangement of DNA molecules to be used in the orderly arrangement of nanostructures.

In the molecular and organic electronics area, beyond today's electronics that have developed based on silicon and inorganic semiconductors, electronics with basic units in the form of organic semiconductors and molecules is expected to play a major role. As for the significance of and outlook for this area, expectations for post-CMOS, development towards large-area electronics, expected achievement of ubiquitous environments, development towards quantum computers, and propagation effects for environmental and energy problems through the achievement of ultralow power consumption can be listed.

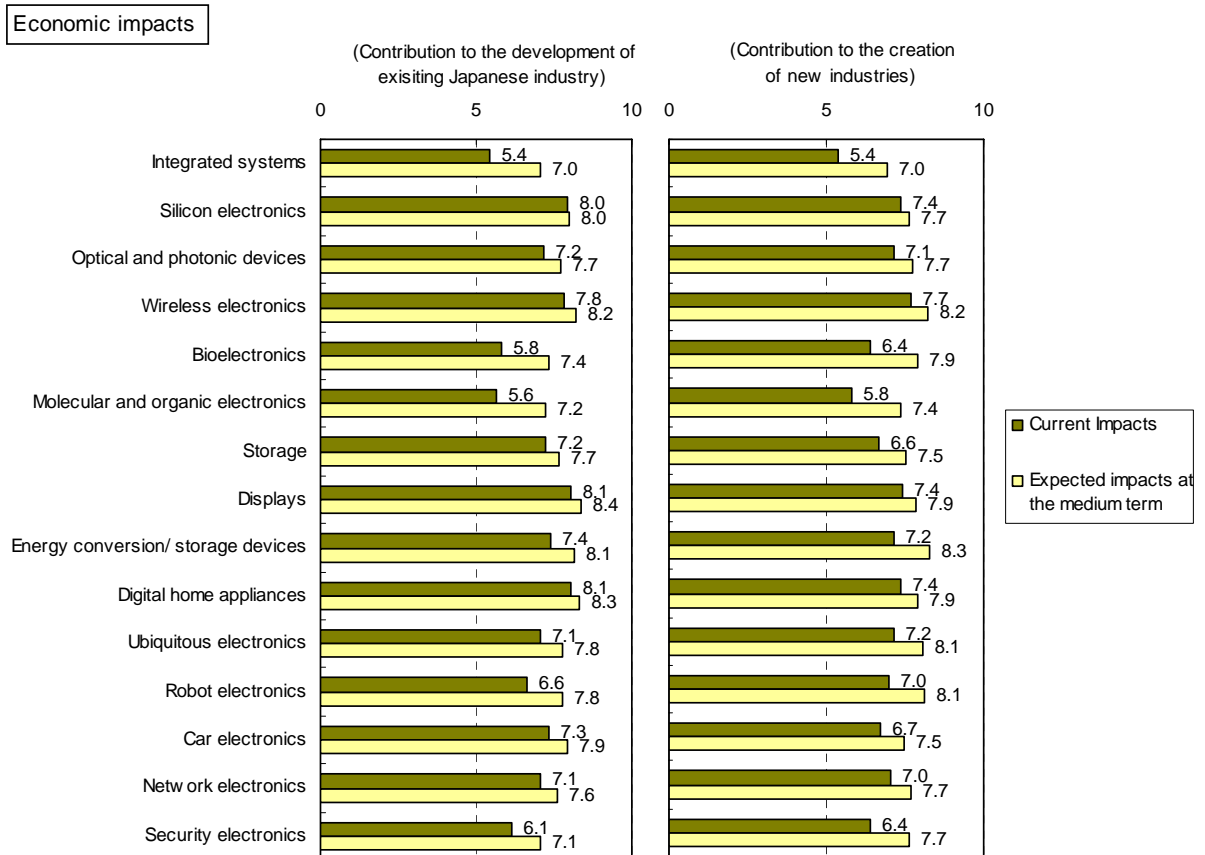
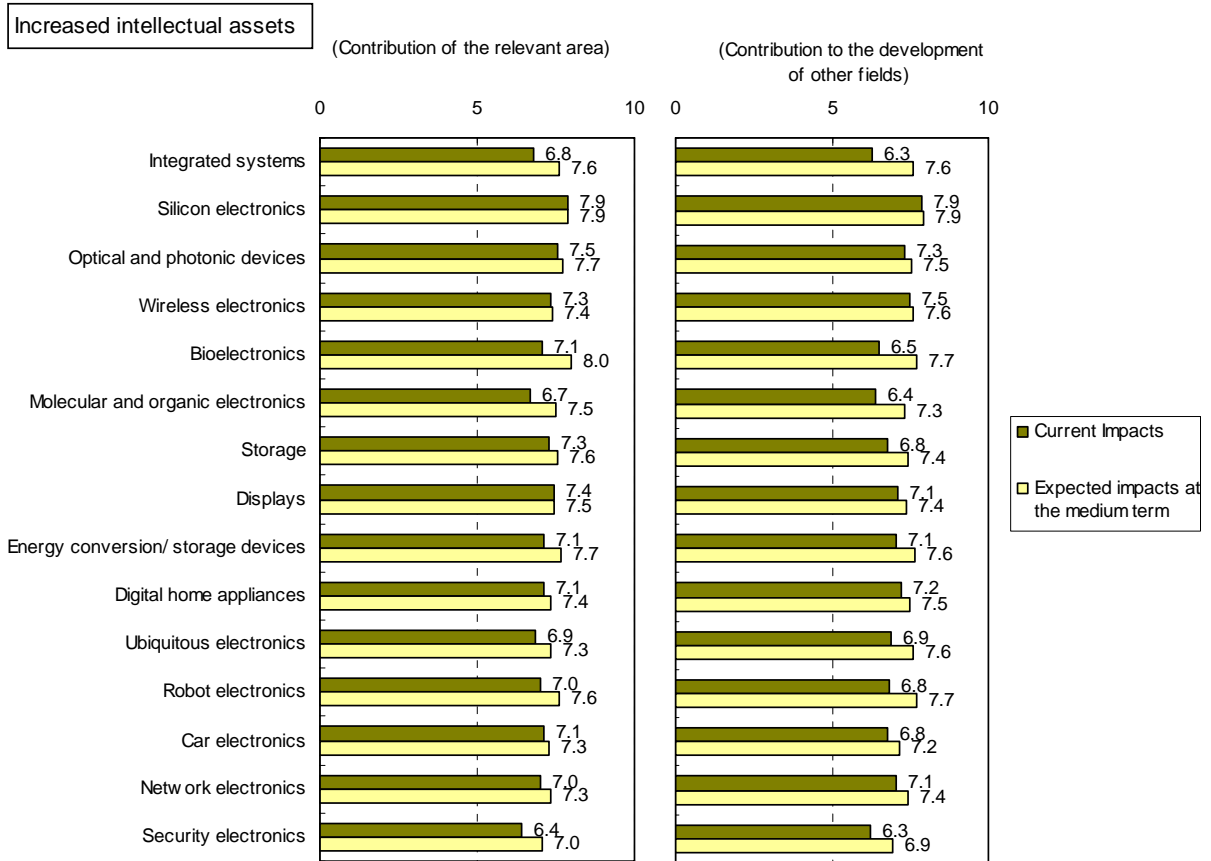
In the area of storage, applications using the integration of optics and magnetism, the near field of light, and spintronics are being researched as technologies extending into the future, with the goal of a greater than 100-fold improvement in recording density. Expectations are also high for leading-edge research such as memory in which each atom or molecule holds one bit of data, probe arrays, and other forms of memory based on new principles that are not extensions of current technology. Display technology includes three-dimensional displays, large high-definition displays with outstanding realism, and flexible displays for use with ubiquitous data networks. Although some methods have yet to be determined, steady progress is being made.

Development is expected in the energy conversion/storage devices area as well. Examples of conceivable compact, portable energy devices are solar cells that utilize light energy, fuel cells that utilize chemical energy, and compact generators that utilize heat and vibrational energy.

(ARAKAWA Yasuhiro)

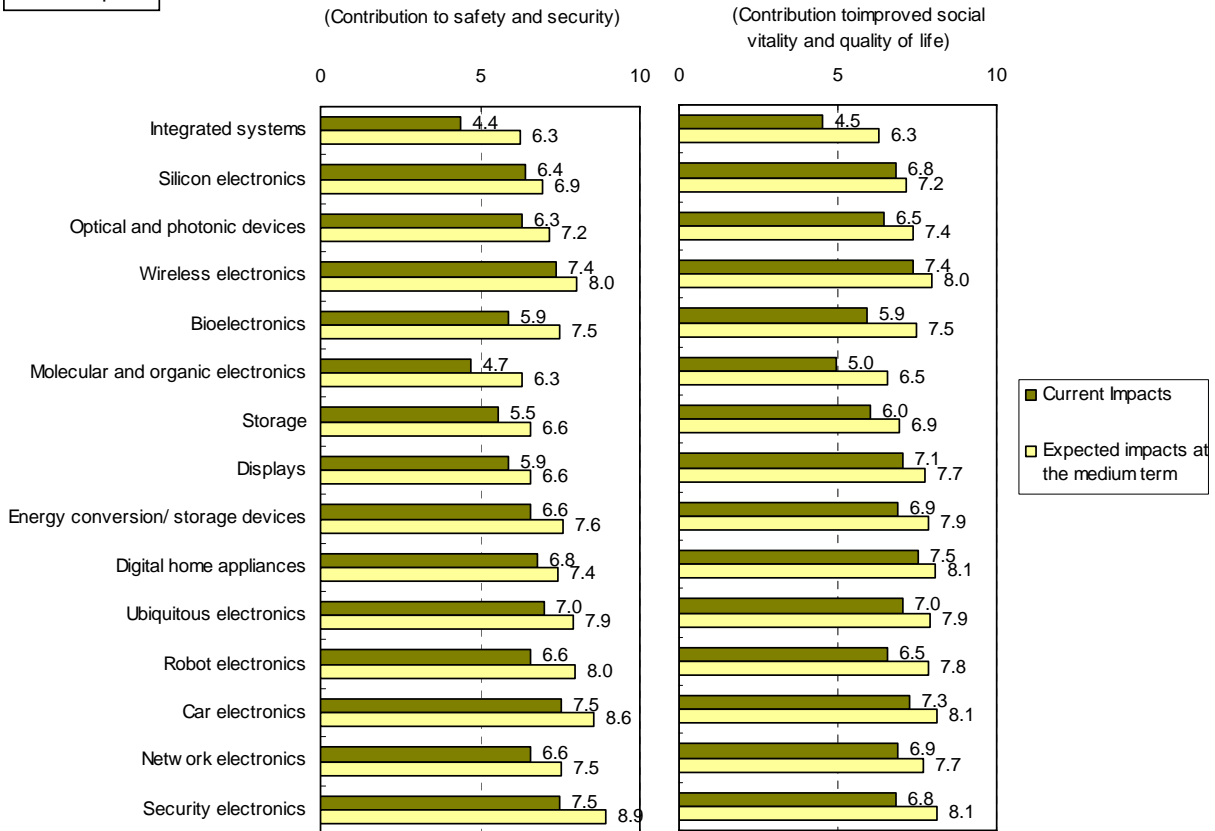
2.2. Main results

A. Impacts

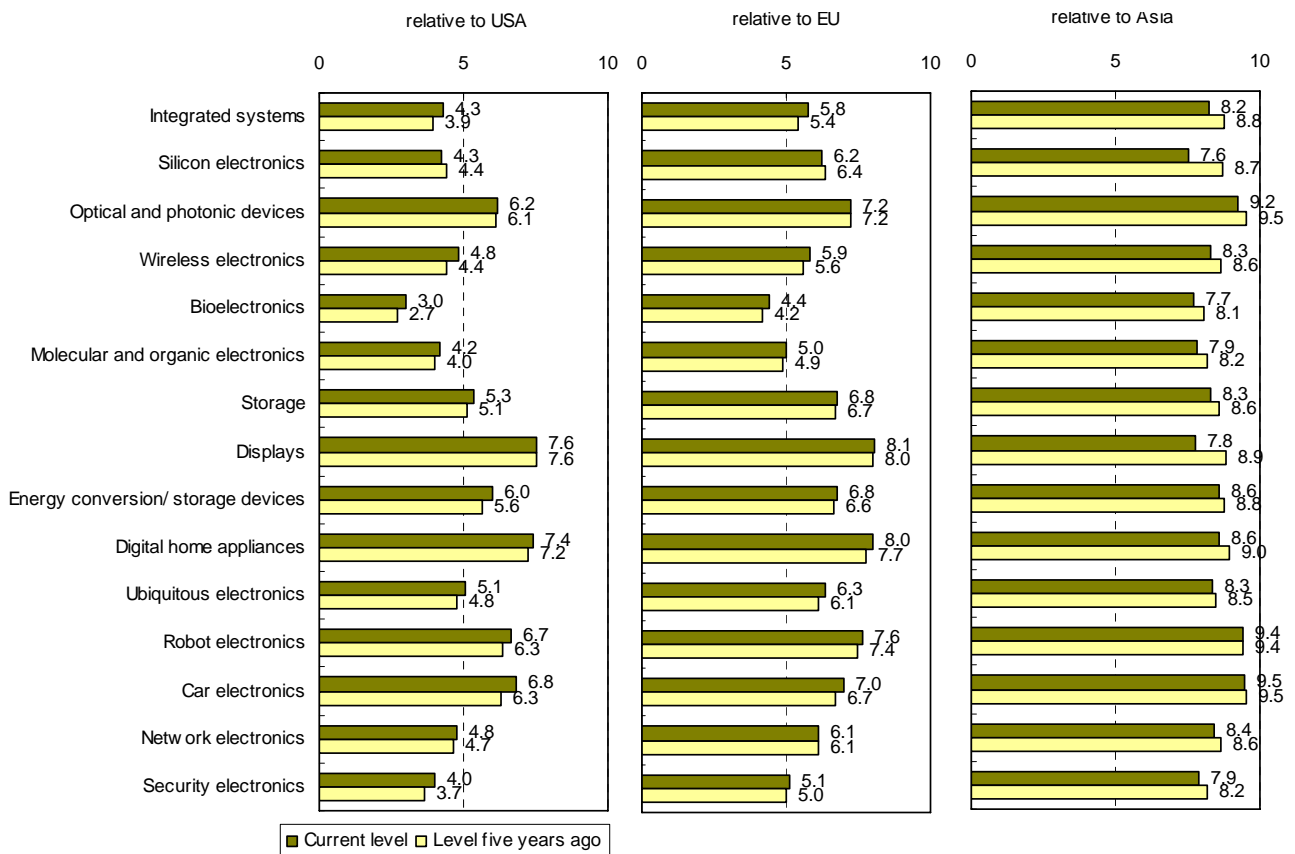


*Responses are indexed on a 10-point scale.

Social impacts

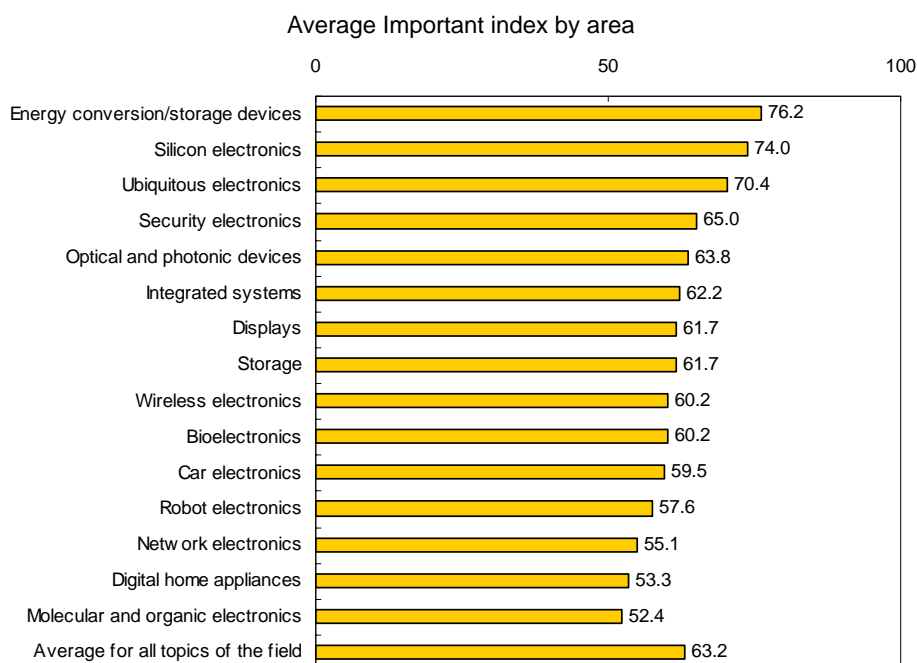


B. Japan's R&D Level



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C. Importance to Japan



The most important 10 topics

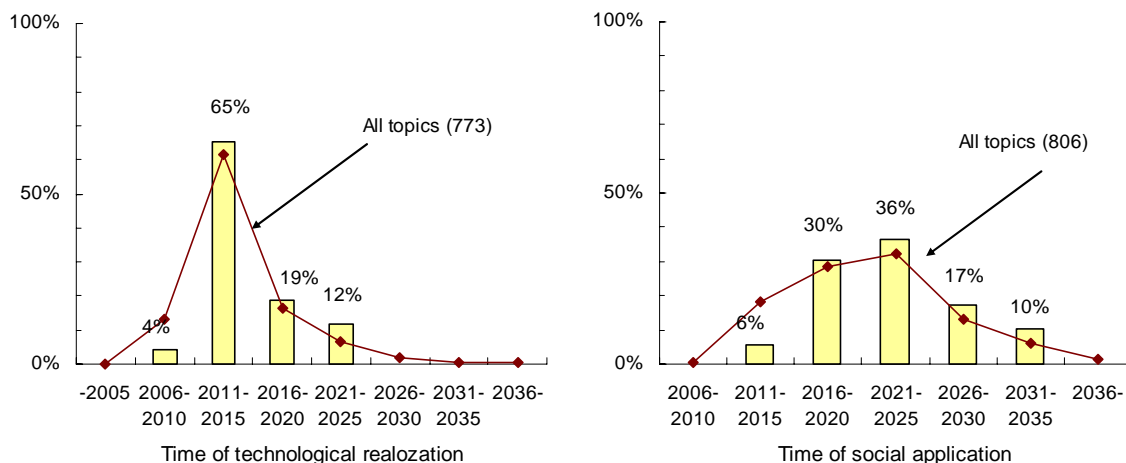
Topic	Index	Year T*	Year S*
1 68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	93	2015	2023
2 13: A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.	88	2013	2019
3 17: Almost all indoor lighting is replaced by semiconductor light sources.	86	2012	2018
4 06: A 100M-gate LSI whose logical function changes in real time.	86	2013	2021
5 15: Widespread home use of 10-Gbps access networks.	85	2012	2017
6 05: A microprocessor LSI with a clock frequency of 50 GHz or higher.	85	2014	2021
7 07: An LSI containing transistors with a gate length of 3 nm.	84	2015	2023
8 08: An LSI chip with a storage capacity of 256 gigabits or larger.	83	2015	2022
9 46: The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.	83	2012	2018
10 47: A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.	82	2016	2025

Year T: Time of technological realization Year S: Time of social application

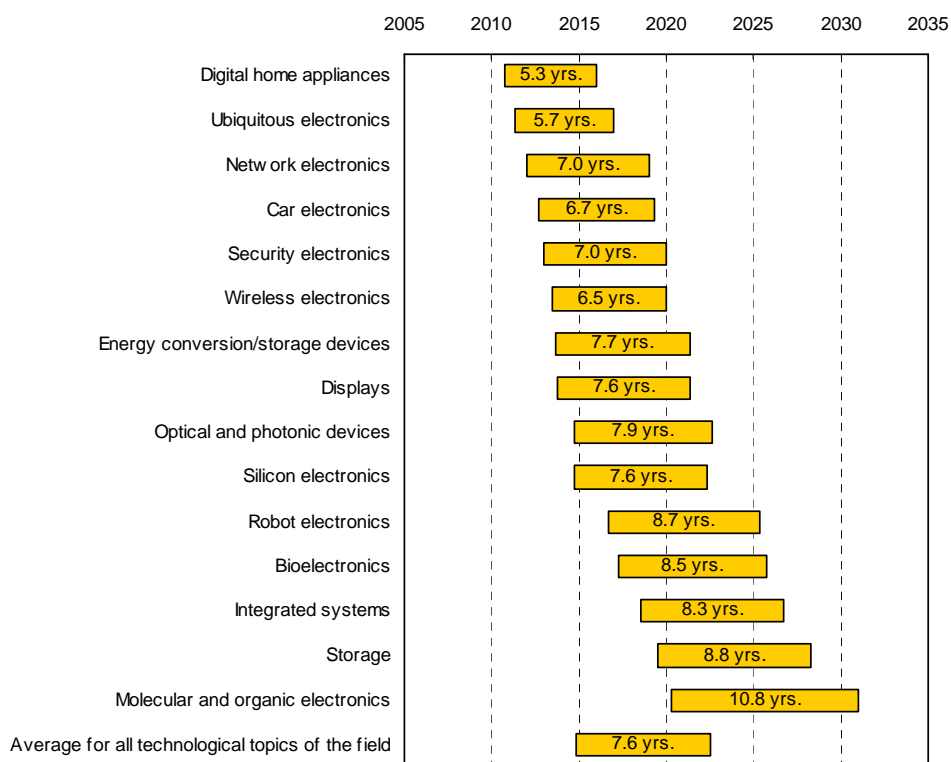
*Responses were indexed on a 100-point scale.

D. Time of realization

Distribution of topics



Gap between technological realization and social application



Topics with short or long periods until social application

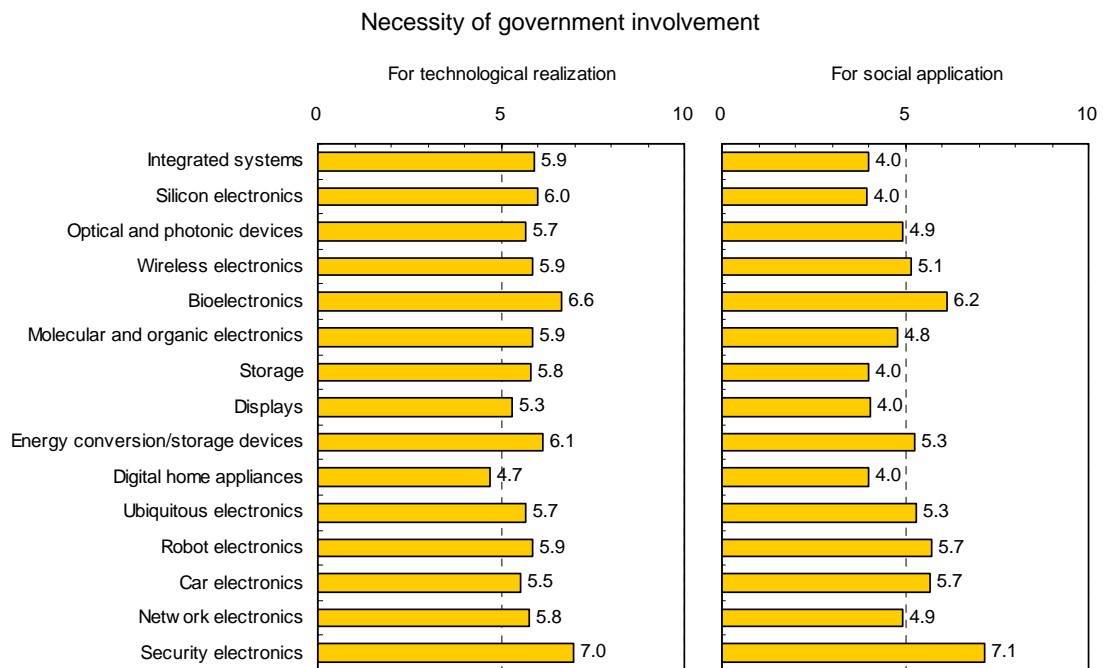
Topic	Year T*	Period*	Area
34: A logic/memory LSI that uses a single molecule as the basic switching element.	2022	11	Molecular and organic electronics
35: Five-sense sensors with a sensitivity equivalent to humans.	2021	11	Molecular and organic electronics
36: An LSI containing carbon nanotube transistors.	2018	11	Molecular and organic electronics
22: Secure optical quantum communications system.	2018	10	Optical and photonic devices
24: Large-capacity optical buffer memory.	2018	10	Optical and photonic devices

Topic	Year T*	Period*	Area
32: A micromachine-based health care device that can be implanted in the human body.	2015	10	Bioelectronics
33: Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.	2020	10	Molecular and organic electronics
59: A system that automatically drives a car to the specified destination.	2016	10	Car electronics

Topic	Year T*	Period*	Area
49: LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.	2011	4	Digital home appliances
15: Widespread home use of 10-Gbps access networks.	2012	5	Optical and photonic devices
41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).	2011	5	Displays
52: Fully wireless office and home environments that obviate the need for the physical connection.	2009	5	Digital home appliances
53: A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.	2012	5	Ubiquitous electronics
54: RF tags for attaching to most everyday items to help to track their location and state.	2008	5	Ubiquitous electronics
60: An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.	2011	5	Car electronics
61: Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.	2011	5	Car electronics
69: Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.	2009	5	Security electronics

*Year T: Time of technological realization Period: Period until social application (years)

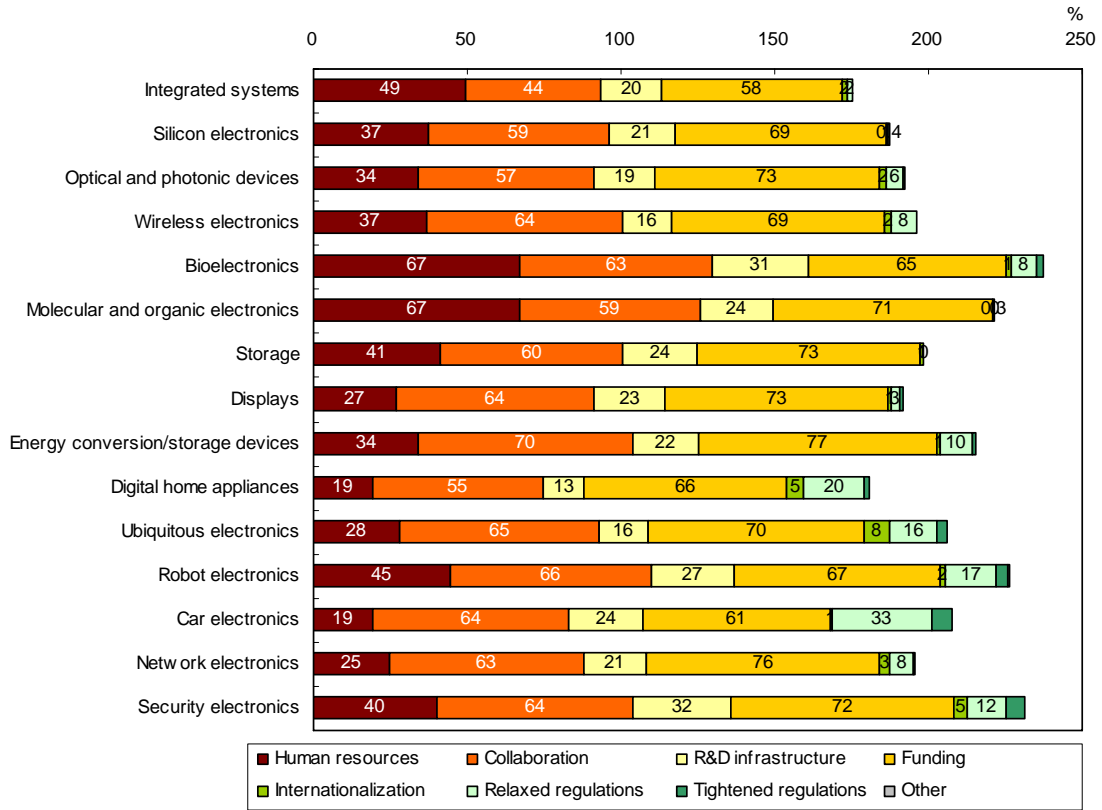
E. Effective measures that should taken by government



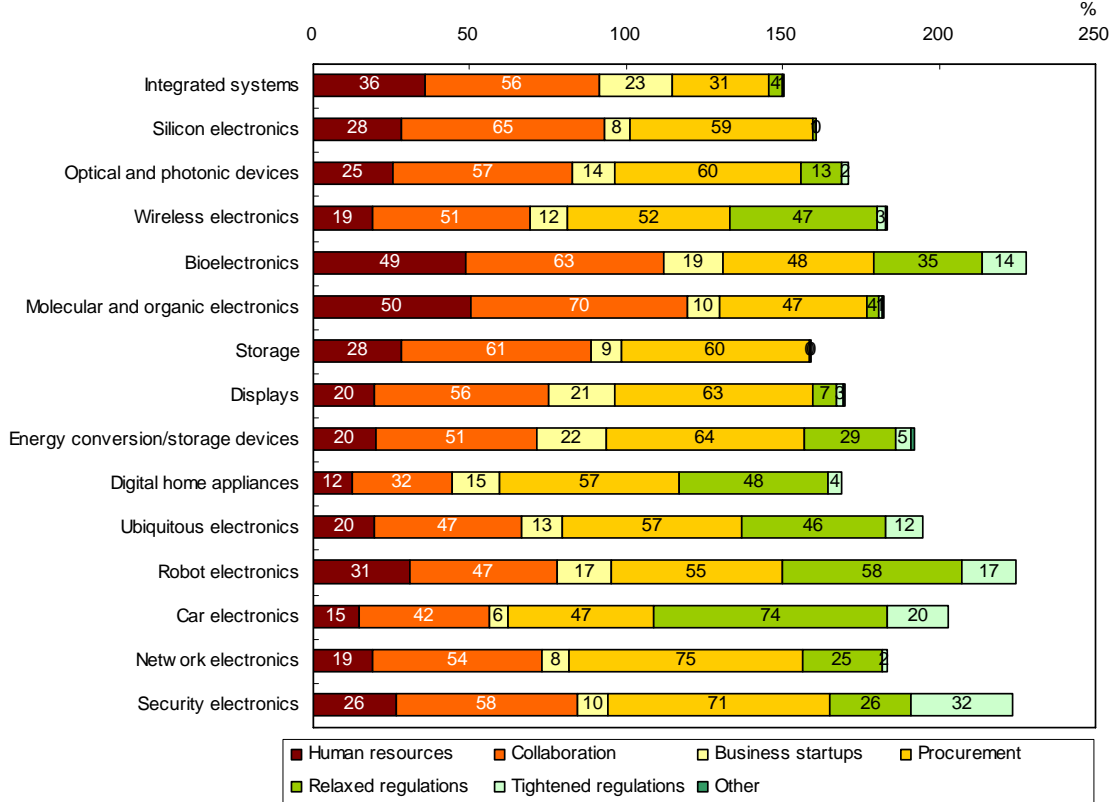
*Responses were indexed on a 10-point scale

Effective measures

For technological realization



For social application



F. Time-line of topics

Technological realization

year	topic
2008	<p>54: RF tags for attaching to most everyday items to help to track their location and state.</p> <p>52: Fully wireless office and home environments that obviate the need for the physical connection.</p> <p>69: Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.</p>
2011	<p>41: A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).</p> <p>49: LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.</p> <p>50: A high-resolution video distribution system that allows searching through and distribution of TV, film, and music archives of the past few years.</p> <p>60: An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.</p> <p>61: Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.</p> <p>63: Technology for time division transmission at 100 Gbps or faster.</p>
2012	<p>11: An LSI operating based on nonvolatile logic.</p> <p>15: Widespread home use of 10-Gbps access networks.</p> <p>17: Almost all indoor lighting is replaced by semiconductor light sources.</p> <p>28: A wireless system in which terminals mutually communicate to form a network (a wireless system in which remote terminals are linked through multiple intermediate terminals, rather than through communications between the terminal and the access point, such as the base station, as in mobile telephone networks and wireless LANs).</p> <p>46: The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.</p> <p>51: Wall-mounted panels and furnishings with communications, sensing, displaying, lighting and other capabilities.</p> <p>53: A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.</p> <p>62: Technology with which HDTV video (about 1.5 Gbps) can be transmitted to any remote place without delays due to compression and other processing.</p>
2013	<p>04: A wearable automatic translation device with voice input and output capability.</p> <p>06: A 100M-gate LSI whose logical function changes in real time.</p> <p>13: A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.</p> <p>14: Organic material devices (e.g. lasers and switches).</p> <p>19: Ultraviolet/deep-ultraviolet laser diodes.</p> <p>20: Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.</p> <p>26: A card-size software radio whose specifications, including center frequency, bandwidth, modulation method, and error correction method, can be changed in software.</p> <p>27: A wireless terminal that can autonomously operate whenever necessary, using natural energy (e.g. many dispersed sensors (wireless terminals) autonomously send alarms to the central system depending on their sensed values, without the need for an external power supply).</p> <p>31: A miniature chemical analysis system for checking food or environmental safety on the spot.</p> <p>48: A miniature electric generator that uses thermal or vibration energy and may be embedded in IC tags.</p> <p>64: Large-scale (about 1000x1000) optical cross-connect equipment</p> <p>67: Non-contact detectors for drugs, toxic gases, biological weapons, etc.</p>
2014	<p>05: A microprocessor LSI with a clock frequency of 50 GHz or higher.</p> <p>10: An LSI with on-chip optical interconnect</p> <p>12: A fault-tolerant logic LSI with self-repair capability.</p> <p>18: Photonic sensing technology using an unused radio frequency range of 1-10 THz.</p>

year	topic
	<p>21: Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers).</p> <p>42: A 3D video display that may be viewed without wearing special glasses and shows undistorted images even when the viewer makes certain natural movements such as shifting the body.</p> <p>43: An organic emissive display that is so large as to cover an entire wall.</p> <p>55: A system that provides information services most suited for the users and their situation without instructions from them.</p> <p>65: A biometric authentication system capable of non-contact, high-accuracy identification of individuals from a distance of about 10 m (with an authentication performance equivalent to the current fingerprint authentication systems and for potential applications such as quick access control without slowing the flow of people walking along the passage).</p> <p>66: Widespread use of portable authentication technologies that can quickly authenticate individuals based on their DNA.</p>
2015	<p>03: An artificial intelligence chip capable of understanding human feelings from facial expressions.</p> <p>07: An LSI containing transistors with a gate length of 3 nm.</p> <p>08: An LSI chip with a storage capacity of 256 gigabits or larger.</p> <p>23: Photonic-crystal-based photonic integrated circuits.</p> <p>32: A micromachine-based health care device that can be implanted in the human body.</p> <p>44: A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.</p> <p>45: A folding display that is equivalent to newspaper in size, thickness, and resolution.</p> <p>56: It becomes popular that every family has a household helper robot capable of doing the washing, cleaning, and other household chores.</p> <p>68: A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.</p>
2016	<p>25: A broadband solid-state amplifier operating in a DC to 1000 GHz range.</p> <p>47: A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.</p> <p>59: A system that automatically drives a car to the specified destination.</p>
2017	<p>38: A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).</p> <p>39: An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).</p> <p>58: Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.</p>
2018	<p>22: Secure optical quantum communications system.</p> <p>24: Large-capacity optical buffer memory.</p> <p>36: An LSI containing carbon nanotube transistors.</p> <p>57: A microrobot that contains sensors, controllers, and actuators tightly packed using micromachine technology and can be sent into the human body for medical examination.</p>
2019	<p>29: Electronics technology with new capabilities achieved through fusion between electronics and biomechanisms at the single-cell/-molecule level (e.g. devices for diagnosis and drug development).</p>
2020	<p>16: Soft X-ray laser at a few tens of angstroms of wavelength.</p> <p>33: Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.</p>
2021	<p>35: Five-sense sensors with a sensitivity equivalent to humans.</p> <p>40: A large-scale probe array memory with a storage density of 10 terabits or more per square inch.</p>
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2023	<p>09: An LSI using high-temperature superconductivity material for wiring.</p> <p>37: A storage system that stores a bit of data by using a single atom/molecule.</p>
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Social application

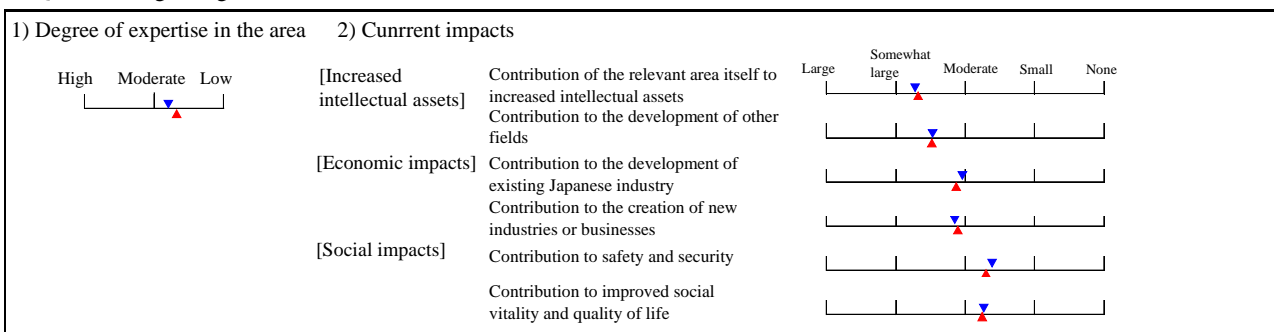
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2026	<p>38: A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).</p> <p>39: An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).</p> <p>58: Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.</p> <p>59: A system that automatically drives a car to the specified destination.</p>
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Appendix: Results of R1 and R2

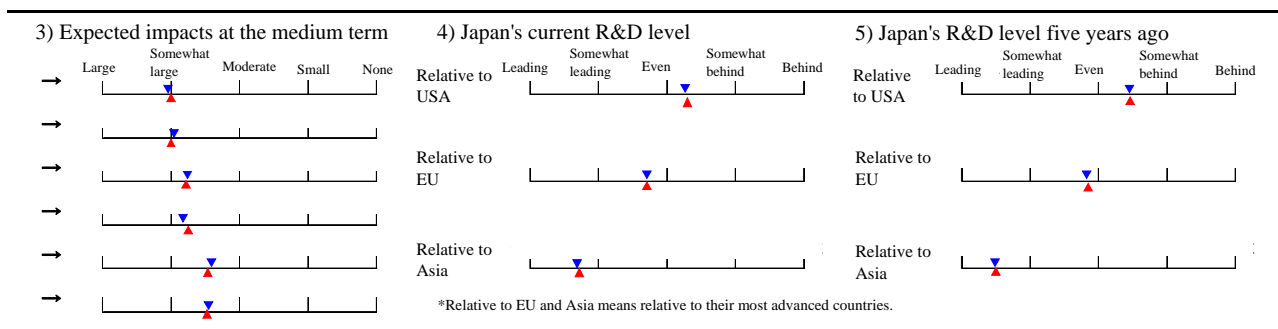
I. Integrated systems

1. Questions regarding the relevant area



2. Questions regarding topics

No	Topic	Questionnaire	Degree of expertise				Importance to Japan				Time of technological realization								
			Respondents (persons)				Index				Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
			High	Moderate	Low	None	High	Moderate	Low	None									
			(%)				(%)				(%)								
1	An information device that uses the quantum computing principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.	1	144	8	42	50	-	71	47	46	7	0						9	9
		2	137	9	28	63	-	68	39	54	7	0						7	6
		E	12	100	0	0	-	88	75	25	0	0						18	0
2	An information device that uses the spintronics principle to achieve three orders of magnitude greater processing power than the CMOS logic circuit in specific applications.	1	133	8	34	58	-	66	37	55	8	0						11	12
		2	128	5	29	66	-	58	22	67	11	0						8	9
		E	7	100	0	0	-	68	43	43	14	0						0	0
3	An artificial intelligence chip capable of understanding human feelings from facial expressions.	1	137	8	33	59	-	57	29	43	27	1						4	7
		2	128	5	19	76	-	49	10	67	23	0						2	0
		E	6	100	0	0	-	54	17	66	17	0						0	0
4	A wearable automatic translation device with voice input and output capability.	1	145	6	30	64	-	73	52	38	10	0						1	2
		2	129	2	16	82	-	74	51	43	6	0						0	0
		E	3	100	0	0	-	50	0	100	0	0						0	0



Countries at the leading edge	Regarding technological realization													Time of social application					Regarding social application															
	Necessity of gov't involvement				Effective measures that should be taken by gov't									2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied		Do not know		Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities						Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	(%)	(%)	(%)	(%)	(%)	(%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups
18	76	6	0	0	39	34	20	7	57	39	43	52	17	4	0	0						10	13	19	29	32	20	43	47	24	39	8	3	1
2	98	0	0	0	33	51	12	4	75	21	27	59	1	2	0	0						8	11	4	33	48	15	54	55	10	33	2	1	0
8	92	0	0	0	42	50	0	8	64	36	18	82	9	0	0	0						8	8	17	33	42	8	64	55	0	45	9	0	0
29	69	2	0	0	31	46	16	7	49	46	40	53	13	3	0	0						12	15	11	40	32	17	40	49	25	41	8	0	2
16	83	1	0	0	18	62	14	6	67	26	28	61	0	2	0	0						11	11	3	34	46	17	46	56	11	36	1	0	0
29	71	0	0	0	43	14	29	14	67	0	33	50	0	0	0	0						0	0	0	29	29	42	50	25	0	75	0	0	0
30	68	2	0	0	16	36	38	10	34	57	28	49	6	5	1	1						1	10	10	29	37	24	26	42	39	31	18	6	1
13	85	1	1	0	4	41	46	9	30	64	13	58	0	3	0	0						2	2	2	22	59	17	20	53	35	26	7	2	0
20	80	0	0	0	0	34	33	33	25	25	25	100	0	0	0	0						0	0	0	0	67	33	25	25	50	25	25	0	0
56	39	4	1	0	20	39	33	8	25	62	22	49	13	8	1	1						1	4	10	32	31	27	22	47	41	34	16	1	1
77	21	2	0	0	10	51	33	6	25	66	13	56	6	2	0	0						0	1	1	35	47	17	22	58	38	29	8	0	0
67	33	0	0	0	0	0	67	33	50	50	0	50	0	0	0	0						0	0	0	0	67	33	100	50	50	50	0	0	0

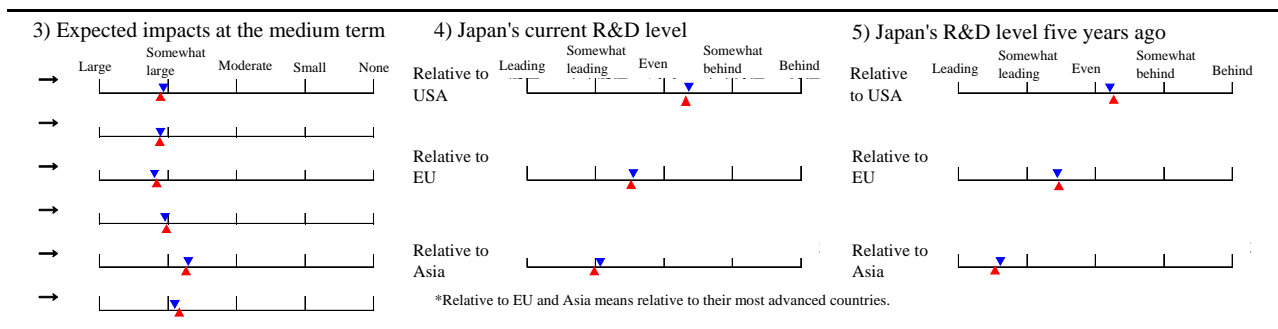
II. Silicon electronics

1. Questions regarding the relevant area


1) Degree of expertise in the area		2) Current impacts	
High	Moderate	Low	
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	Contribution to the development of other fields	
[Economic impacts]	Contribution to the development of existing Japanese industry	Contribution to the creation of new industries or businesses	
[Social impacts]	Contribution to safety and security	Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan				Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
				(%)				(%)				(%)									
5	A microprocessor LSI with a clock frequency of 50 GHz or higher.	1	139	21	39	40	-	76	56	37	6	1								9	2
		2	128	15	35	50	-	85	71	27	2	0								3	1
		E	19	100	0	0	-	82	63	37	0	0								5	0
6	A 100M-gate LSI whose logical function changes in real time.	1	126	17	44	39	-	78	58	40	2	0								1	2
		2	120	8	44	48	-	86	73	25	2	0								0	0
		E	10	100	0	0	-	90	80	20	0	0								0	0
7	An LSI containing transistors with a gate length of 3 nm.	1	141	26	39	35	-	77	57	38	4	1								9	6
		2	129	26	33	41	-	84	69	29	2	0								3	2
		E	34	100	0	0	-	87	74	26	0	0								6	3
8	An LSI chip with a storage capacity of 256 gigabits or larger.	1	140	21	43	36	-	75	53	41	5	1								3	4
		2	126	17	42	41	-	83	68	28	4	0								2	1
		E	22	100	0	0	-	93	86	14	0	0								5	0
9	An LSI using high-temperature superconductivity material for wiring.	1	126	10	39	51	-	46	13	52	27	8								20	20
		2	125	7	27	66	-	41	4	55	38	3								18	14
		E	9	100	0	0	-	44	11	56	22	11								33	33
10	An LSI with on-chip optical interconnect	1	143	26	40	34	-	67	42	46	9	3								6	7
		2	131	14	45	41	-	65	35	57	7	1								4	3
		E	18	100	0	0	-	69	47	41	6	6								17	0
11	An LSI operating based on nonvolatile logic.	1	116	16	40	44	-	72	48	44	7	1								0	3
		2	110	10	37	53	-	76	53	44	3	0								0	1
		E	11	100	0	0	-	88	80	10	10	0								0	0
12	A fault-tolerant logic LSI with self-repair capability.	1	112	10	29	61	-	66	38	49	12	1								1	10
		2	105	4	26	70	-	59	23	68	8	1								1	4
		E	4	100	0	0	-	75	67	0	33	0								0	0



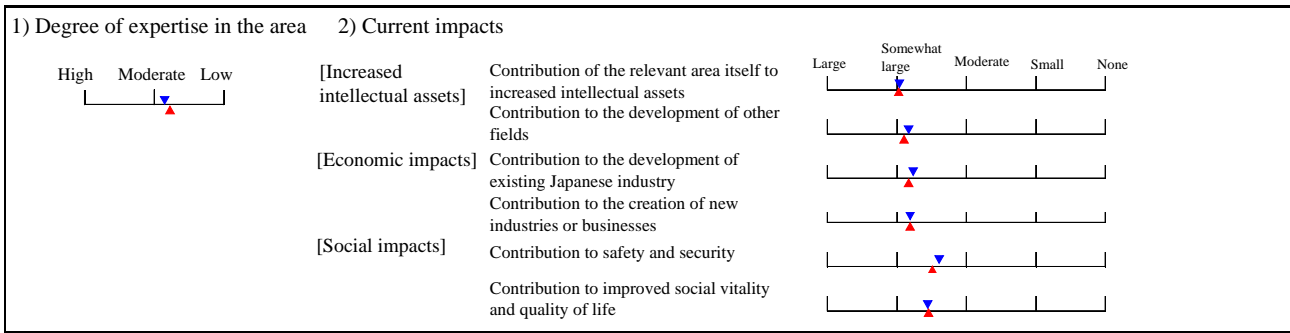
Countries at the leading edge	Regarding technological realization										Time of social application					Regarding social application																	
	Necessity of gov't involvement				Effective measures that should be taken by gov't						2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	Necessity of gov't involvement				Effective measures that should be taken by gov't											
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration								Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations
(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)					
5	95	0	0	0	31	36	17	16	35	52	37	64	8	5	0	0					8	4	19	26	25	30	37	53	19	55	9	2	0
0	100	0	0	0	20	58	16	6	39	59	25	68	2	0	0	0					4	2	4	36	33	27	31	65	7	60	0	0	0
0	100	0	0	0	26	47	16	11	41	53	18	59	6	0	0	0					11	0	5	32	26	37	25	83	17	50	0	0	0
20	78	2	0	0	21	49	18	12	36	51	36	66	5	5	1	0					0	3	15	33	25	27	35	53	21	55	8	0	0
3	96	0	1	0	14	68	13	5	35	58	21	72	1	0	0	0					1	1	3	40	35	22	29	64	9	60	0	0	0
0	100	0	0	0	40	40	20	0	50	20	20	70	0	0	0	0					10	0	0	30	40	30	43	43	29	71	0	0	0
36	62	1	1	0	29	40	21	10	30	52	42	64	5	2	0	0					9	7	18	26	30	26	37	50	18	51	8	0	1
19	81	0	0	0	18	64	13	5	35	69	24	68	0	0	0	0					6	3	4	33	41	22	29	62	7	58	0	0	0
22	78	0	0	0	24	49	18	9	45	61	23	61	0	0	0	0					9	0	6	33	43	18	38	46	4	62	0	0	0
25	36	2	37	0	23	42	24	11	27	47	37	62	6	3	0	0					3	6	15	28	27	30	35	51	20	51	7	1	1
20	38	0	42	0	15	60	19	6	26	60	22	72	1	0	0	0					2	2	3	35	39	23	23	59	3	64	1	1	0
19	14	0	67	0	27	50	14	9	40	55	25	75	0	0	0	0					5	0	5	32	36	27	38	63	0	63	6	0	0
43	50	4	0	3	13	37	28	22	35	49	35	43	7	3	0	1					26	28	8	27	28	37	41	58	22	39	9	0	0
31	69	0	0	0	3	53	30	14	37	60	24	55	0	0	0	0					25	18	2	23	42	33	35	74	6	45	0	0	0
62	38	0	0	0	22	11	22	45	80	20	20	60	0	0	0	0					44	33	0	22	45	33	33	50	0	67	0	0	0
44	53	2	0	1	26	41	22	11	34	55	41	54	4	2	0	0					9	12	17	28	23	32	39	57	21	44	7	0	1
39	61	0	0	0	13	65	14	8	34	70	26	67	0	0	0	0					7	5	4	44	29	23	27	77	8	53	0	0	0
47	53	0	0	0	27	28	17	28	54	54	23	62	0	0	0	0					22	0	0	33	39	28	38	62	8	46	0	0	0
28	70	2	0	0	21	39	24	16	39	37	28	66	5	4	0	0					0	3	14	28	33	25	32	45	37	41	10	0	0
9	91	0	0	0	9	56	27	8	45	41	13	74	0	0	0	1					0	2	4	26	46	24	26	62	11	60	0	0	0
10	90	0	0	0	27	18	46	9	60	40	30	50	0	0	0	0					0	0	9	27	37	27	25	50	13	63	0	0	0
13	84	3	0	0	17	45	29	9	44	42	28	58	5	5	1	0					2	12	9	33	38	20	35	47	30	42	9	1	0
2	98	0	0	0	6	61	26	7	55	48	9	71	0	0	0	0					1	5	1	25	51	23	33	64	10	50	0	0	0
0	100	0	0	0	25	25	25	25	67	33	0	33	0	0	0	0					0	0	0	25	50	25	67	67	33	33	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know		
				(%)				(%)					(%)									
13	A small-scale semiconductor fabrication plant that supports high-mix, low-volume production and allows a two orders of magnitude reduction in capital investment from the current levels.	1	136	14	32	54	-	77	60	32	7	1								7	10	
		2	122	10	20	70	-	88	76	21	3	0									4	4
		E	12	100	0	0	-	95	91	9	0	0										17

Countries at the leading edge					Regarding technological realization										Time of social application					Regarding social application														
					Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't										
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)					(%)				(%)						(%)					(%)														
64	24	3	6	3	26	40	22	12	29	50	37	61	8	13	0	0						6	11	25	35	27	13	25	48	29	58	19	4	0
90	8	0	2	0	17	68	10	5	30	67	25	72	2	4	0	0						6	5	8	57	18	17	19	57	14	77	7	1	0
92	0	0	8	0	25	67	0	8	27	55	18	55	9	9	0	0						17	0	17	58	17	8	27	45	0	73	9	0	0

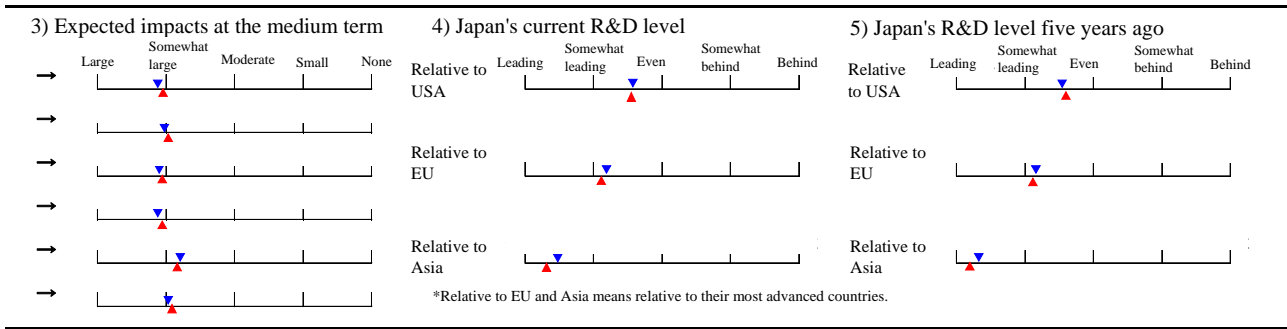
III. Optical and photonic devices

1. Questions regarding the relevant area

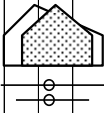
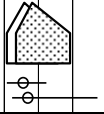
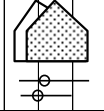


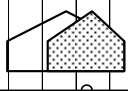
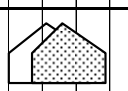
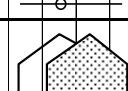
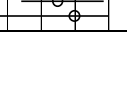





2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan				Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
				(%)				(%)				(%)									
14	Organic material devices (e.g. lasers and switches).	1	132	14	38	48	-	60	26	61	13	0								0	5
		2	127	9	34	57	-	57	19	74	7	0								0	2
		E	11	100	0	0	-	55	18	64	18	0									0
15	Widespread home use of 10-Gbps access networks.	1	145	26	32	42	-	75	55	36	8	1								1	3
		2	128	19	35	46	-	85	73	23	3	1								0	0
		E	24	100	0	0	-	88	79	17	4	0								0	0
16	Soft X-ray laser at a few tens of angstroms of wavelength.	1	93	9	33	58	-	46	11	54	31	4								0	14
		2	97	2	18	80	-	44	2	70	28	0								0	8
		E	2	100	0	0	-	25	0	0	100	0								0	0
17	Almost all indoor lighting is replaced by semiconductor light sources.	1	150	21	37	42	-	74	54	36	9	1								5	1
		2	135	14	34	52	-	86	74	23	3	0								2	0
		E	19	100	0	0	-	87	78	11	11	0								5	0
18	Photonic sensing technology using an unused radio frequency range of 1-10 THz.	1	115	11	42	47	-	55	21	62	14	3								2	4
		2	112	12	29	59	-	52	9	79	12	0								1	1
		E	13	100	0	0	-	63	31	61	8	0								0	0
19	Ultraviolet/deep-ultraviolet laser diodes.	1	119	24	33	43	-	64	35	51	14	0								0	4
		2	115	17	24	59	-	57	20	70	10	0								0	3
		E	20	100	0	0	-	76	57	32	11	0								0	5
20	Optical multiplex communications equipments capable of transmitting multiplexed signals at 100 Tbps over a single optical fiber.	1	120	24	38	38	-	72	49	42	8	1								3	8
		2	115	22	29	49	-	79	60	34	5	1								3	1
		E	25	100	0	0	-	75	56	32	12	0								4	0
21	Ultralow-loss (e.g. 0.1 dB/km or lower) holey fibers (photonic crystal fibers).	1	107	18	40	42	-	56	24	55	19	2								4	4
		2	104	14	25	61	-	53	15	68	16	1								3	2
		E	15	100	0	0	-	60	33	40	27	0								7	0



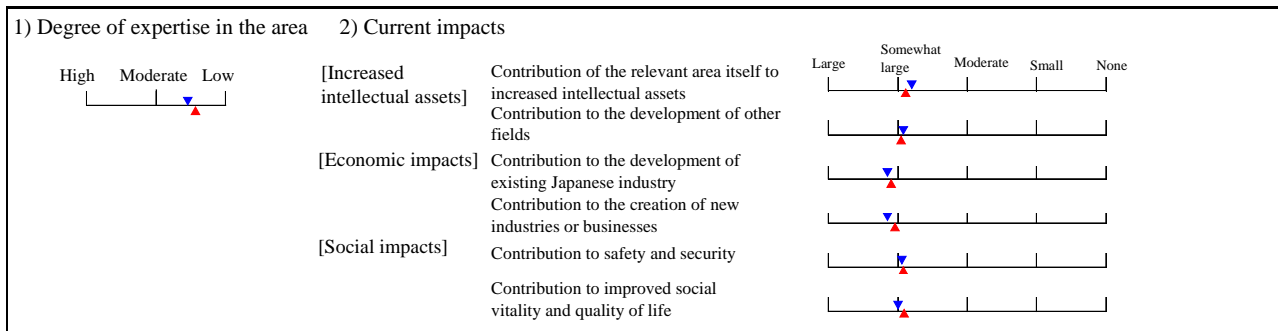
Countries at the leading edge						Regarding technological realization										Time of social application					Regarding social application																
						Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't												
Japan	USA	EU	Asia	Other		High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		
(%)						(%)				(%)						(%)					(%)																
39	52	8	0	1	17	47	27	9	37	56	31	59	4	4	0	0									2	7	12	35	28	25	34	53	32	39	7	1	0
32	67	1	0	0	4	69	20	7	41	61	21	67	0	0	0	0									0	4	1	47	31	21	33	66	14	50	0	0	0
18	73	9	0	0	0	73	9	18	67	44	44	67	0	0	0	0									0	0	0	70	10	20	63	88	25	38	0	0	0
71	26	1	2	0	21	37	26	16	19	43	29	47	11	32	3	0									3	6	30	37	20	13	12	27	25	54	49	3	1
94	6	0	0	0	10	59	22	9	19	54	16	65	2	33	0	1									1	2	22	48	21	9	13	28	14	70	56	1	0
100	0	0	0	0	21	49	17	13	24	38	24	52	0	48	0	0									4	0	26	52	9	13	20	35	10	65	65	0	0
24	64	9	0	3	11	52	26	11	33	33	34	56	6	9	1	1									2	20	11	37	39	13	34	49	24	30	14	7	3
3	95	1	0	1	2	64	25	9	37	43	27	76	1	2	0	0									0	10	2	40	45	13	35	71	6	42	8	0	0
0	100	0	0	0	0	0	50	50	100	100	0	0	0	0	0	0									0	0	0	0	50	50	100	100	0	0	0	0	0
93	6	1	0	0	16	33	31	20	16	49	22	59	7	19	3	0									10	3	21	35	24	20	12	32	25	65	27	10	2
99	1	0	0	0	9	57	27	7	13	58	8	73	5	14	2	0									2	2	7	54	28	11	12	39	16	72	23	5	0
100	0	0	0	0	16	47	21	16	13	63	13	63	13	19	13	0									5	5	17	55	17	11	13	63	13	69	13	13	0
29	60	9	0	2	15	51	24	10	35	49	35	61	5	9	2	1									2	8	14	41	31	14	30	44	33	37	16	12	2
9	85	5	0	1	8	69	17	6	40	66	25	71	1	5	1	0									1	2	5	54	30	11	31	63	17	50	14	4	0
31	61	8	0	0	31	46	15	8	42	67	42	58	0	0	0	0									0	0	15	47	23	15	18	64	18	64	9	18	0
73	25	0	0	2	17	41	26	16	28	47	33	67	5	5	0	0									1	9	14	32	30	24	30	52	34	48	10	2	1
89	9	1	0	1	5	69	20	6	32	64	14	76	1	2	0	0									0	3	2	50	32	16	29	73	13	52	7	1	0
100	0	0	0	0	15	55	10	20	50	69	19	75	0	6	0	0									0	5	11	42	26	21	47	80	13	47	7	7	0
70	29	1	0	0	21	43	26	10	29	42	36	61	7	14	1	0									6	8	21	41	19	19	20	48	19	61	23	4	1
91	9	0	0	0	11	56	28	5	22	57	26	77	3	5	0	0									4	2	11	57	23	9	17	49	12	73	20	0	0
100	0	0	0	0	12	48	36	4	29	50	33	79	0	4	0	0									8	4	16	48	28	8	26	43	22	74	17	0	0
56	35	8	0	1	13	38	33	16	27	48	24	64	6	2	1	1									4	11	12	29	33	26	23	47	20	47	7	0	4
83	15	2	0	0	5	53	30	12	27	61	16	76	3	1	0	0									3	5	5	41	40	14	18	64	12	67	4	0	0
100	0	0	0	0	7	46	20	27	18	64	9	64	0	0	0	0									7	0	7	33	33	27	18	55	18	55	0	0	0

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization							
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know
				(%)				(%)					(%)							
22	Secure optical quantum communications system.	1	118	11	31	58	-	67	42	41	16	1							4	4
		2	114	6	21	73	-	70	43	51	5	1							2	4
		E	7	100	0	0	-	82	72	14	14	0							0	0
23	Photonic-crystal-based potonic integrated circuits.	1	131	21	44	35	-	62	32	52	16	0							3	9
		2	118	14	31	55	-	58	21	68	11	0							3	3
		E	17	100	0	0	-	66	41	41	18	0							0	0
24	Large-capacity optical buffer memory.	1	108	15	35	50	-	63	36	47	14	3							7	9
		2	103	6	27	67	-	61	29	56	14	1							4	6
		E	6	100	0	0	-	63	33	50	17	0							0	0

Countries at the leading edge						Regarding technological realization										Time of social application					Regarding social application														
						Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't										
Japan	USA	EU	Asia	Other		High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other
(%)						(%)				(%)						(%)					(%)														
28	61	10	0	1	28	39	23	10	40	41	40	57	13	8	1	0		8	6	29	35	24	12	29	41	20	49	16	20	4					
9	85	6	0	0	15	69	10	6	58	52	28	75	2	0	0	0		4	6	13	60	20	7	29	57	10	67	6	13	0					
33	17	50	0	0	29	57	0	14	83	50	33	100	0	0	0	0		0	0	14	43	29	14	67	67	0	67	0	17	0					
60	38	2	0	0	22	40	27	11	41	48	32	67	4	4	0	0		6	10	15	28	35	22	31	46	40	44	4	1	1					
83	15	2	0	0	8	67	16	9	48	61	17	77	2	1	1	0		5	5	2	36	47	15	30	62	23	53	2	1	0					
94	0	6	0	0	18	52	6	24	54	54	15	85	0	0	0	0		0	0	0	41	41	18	50	64	14	50	0	0	0					
44	54	0	0	2	22	38	29	11	35	46	32	60	7	3	0	0		7	10	15	24	34	27	36	49	33	45	4	1	1					
26	73	1	0	0	10	54	25	11	37	53	16	77	2	0	0	0		4	6	3	34	48	15	30	62	14	59	1	0	0					
40	60	0	0	0	17	50	0	33	50	75	25	75	0	0	0	0		0	0	17	33	33	17	80	60	40	60	0	0	0					

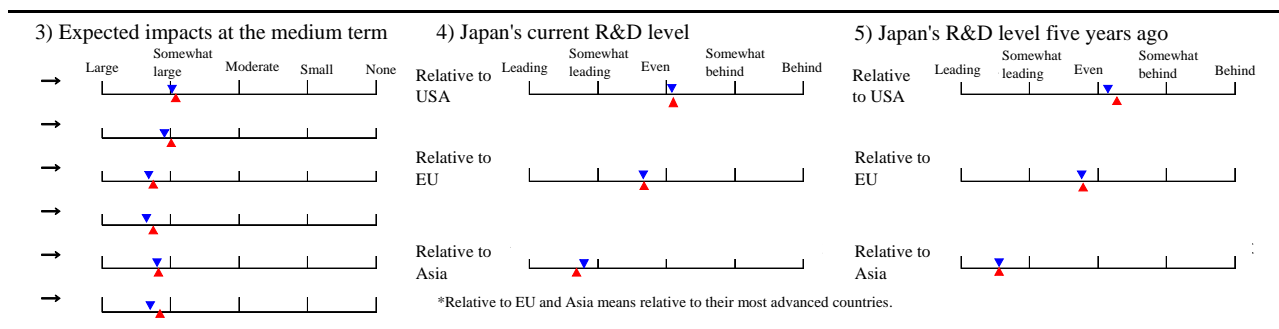
IV. Wireless electronics

1. Questions regarding the relevant area



2. Questions regarding topics

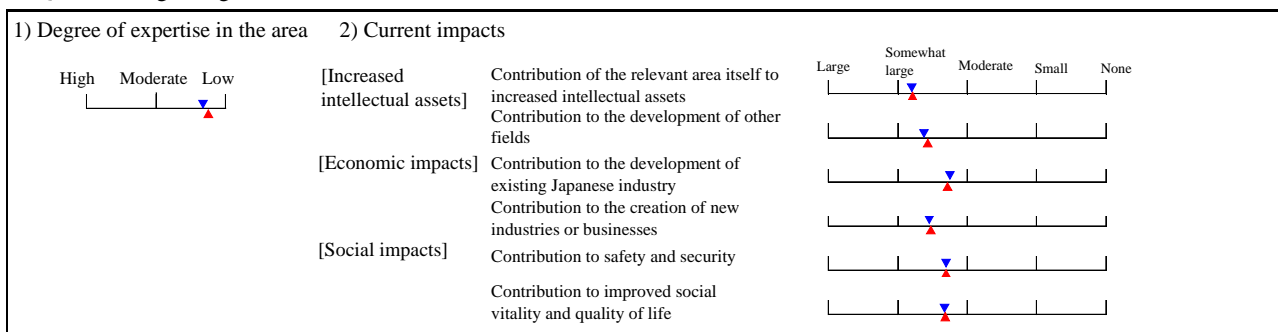
No	Topic	Questionnaire	Degree of expertise				Importance to Japan				Time of technological realization										
			Respondents (persons)				Index				Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know			
			High	Moderate	Low	None	Index	High	Moderate	Low	None										
			(%)				(%)														
25	A broadband solid-state amplifier operating in a DC to 1000 GHz range.	1	101	15	27	58	-	53	18	57	25	0								7	9
		2	94	13	16	71	-	49	6	77	17	0								3	6
		E	12	100	0	0	-	54	17	66	17	0								0	8
26	A card-size software radio whose specifications, including center frequency, bandwidth, modulation method, and error correction method, can be changed in software.	1	107	9	36	55	-	67	40	50	10	0								0	3
		2	99	7	22	71	-	60	24	68	8	0								0	0
		E	7	100	0	0	-	68	43	43	14	0								0	0
27	A wireless terminal that can autonomously operate whenever necessary, using natural energy (e.g. many dispersed sensors (wireless terminals) autonomously send alarms to the central system depending on their sensed values, without the need for an external power supply).	1	124	11	35	54	-	69	45	43	12	0								0	3
		2	110	6	25	69	-	71	46	47	7	0								0	0
		E	7	100	0	0	-	82	72	14	14	0								0	0
28	A wireless system in which terminals mutually communicate to form a network (a wireless system in which remote terminals are linked through multiple intermediate terminals, rather than through communications between the terminal and the access point, such as the base station, as in mobile telephone networks and wireless LANs).	1	114	6	44	50	-	65	39	45	14	2								1	3
		2	107	4	31	65	-	61	27	61	12	0								1	0
		E	4	100	0	0	-	88	75	25	0	0								0	0



Countries at the leading edge	Regarding technological realization												Time of social application					Regarding social application																
	Necessity of gov't involvement				Effective measures that should be taken by gov't								2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied		Do not know		Necessity of gov't involvement				Effective measures that should be taken by gov't								
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding						Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	(%)	(%)	(%)	(%)	(%)	(%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups
20	77	3	0	0	14	41	33	12	40	37	37	60	6	7	0	0						5	15	11	33	33	23	36	42	28	38	22	1	0
3	95	2	0	0	3	64	28	5	45	49	18	73	0	1	0	0						4	7	1	43	34	22	24	63	8	56	8	0	0
18	82	0	0	0	8	67	17	8	45	64	27	82	0	0	0	0						0	8	0	50	25	25	11	56	22	44	11	0	0
19	75	6	0	0	23	41	26	10	36	50	31	63	12	26	2	0						1	6	22	36	26	16	29	38	22	38	50	9	1
4	95	1	0	0	6	66	25	3	35	65	10	71	4	12	0	0						1	1	3	61	22	14	17	42	10	43	63	1	1
0	83	17	0	0	0	86	0	14	17	50	0	67	17	33	0	0						0	0	0	86	0	14	0	67	33	0	50	17	17
34	59	6	0	1	23	44	24	9	41	50	37	59	8	22	4	0						0	7	22	43	23	12	27	41	26	45	51	14	0
20	80	0	0	0	7	71	18	4	35	68	18	69	2	5	0	0						0	1	5	66	21	8	16	53	18	59	53	3	0
33	67	0	0	0	0	72	14	14	33	67	0	67	0	0	0	0						0	0	0	71	0	29	0	80	60	20	20	0	0
20	75	5	0	0	19	41	25	15	38	53	34	52	15	30	5	0						2	5	27	32	25	16	26	35	22	35	58	18	0
8	92	0	0	0	8	71	18	3	31	73	19	65	2	15	0	0						2	2	10	61	20	9	18	45	10	50	66	6	0
0	100	0	0	0	25	50	25	0	50	50	25	75	0	25	0	0						0	0	25	50	25	0	25	50	50	25	25	0	0

V. Bioelectronics

1. Questions regarding the relevant area



2. Questions regarding topics

No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization								
			Respondents (persons)				Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
			High	Moderate	Low	None														(%)
29	Electronics technology with new capabilities achieved through fusion between electronics and biomechanisms at the single-cell-/molecule level (e.g. devices for diagnosis and drug development).	1	89	11	20	69	-	63	31	58	10	1							2	11
		2	83	6	8	86	-	62	26	72	2	0							1	6
		E	5	100	0	0	-	100	100	0	0	0							0	0
30	Technology for fabricating nano-scale integrated circuits as designed, using self-organization and other bottom-up methods.	1	118	11	25	64	-	56	25	53	19	3							14	12
		2	100	8	12	80	-	54	15	71	13	1							9	8
		E	8	100	0	0	-	75	50	50	0	0							0	13
31	A miniature chemical analysis system for checking food or environmental safety on the spot.	1	99	10	23	67	-	66	37	55	7	1							2	4
		2	97	7	15	78	-	62	26	72	2	0							0	3
		E	7	100	0	0	-	100	100	0	0	0							0	0
32	A micromachine-based health care device that can be implanted in the human body.	1	115	16	27	57	-	68	40	51	9	0							0	3
		2	110	8	18	74	-	62	27	68	5	0							0	3
		E	9	100	0	0	-	94	89	11	0	0							0	0

VI. Molecular and organic electronics

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
High	Moderate	Low	
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets		
	Contribution to the development of other fields		
[Economic impacts]	Contribution to the development of existing Japanese industry		
	Contribution to the creation of new industries or businesses		
[Social impacts]	Contribution to safety and security		
	Contribution to improved social vitality and quality of life		

2. Questions regarding topics

No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization								
			Respondents (persons)				Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
			High	Moderate	Low	None														(%)
33	Device fabrication technology and genetic engineering technology based on single-atom/-molecule manipulation.	1	105	5	38	57	-	59	27	56	16	1							2	12
		2	101	5	23	72	-	56	16	74	10	0							0	6
		E	5	100	0	0	-	90	80	20	0	0							0	0
34	A logic/memory LSI that uses a single molecule as the basic switching element.	1	116	5	36	59	-	55	23	51	24	2							9	12
		2	104	5	21	74	-	49	8	73	18	1							9	9
		E	5	100	0	0	-	65	40	40	20	0							20	0
35	Five-sense sensors with a sensitivity equivalent to humans.	1	94	13	34	53	-	61	30	54	16	0							5	3
		2	100	2	23	75	-	55	19	64	17	0							5	2
		E	2	100	0	0	-	100	100	0	0	0							0	0
36	An LSI containing carbon nanotube transistors.	1	125	6	40	54	-	55	24	50	24	2							6	10
		2	118	3	32	65	-	50	9	71	20	0							3	3
		E	4	100	0	0	-	69	50	25	25	0							0	0

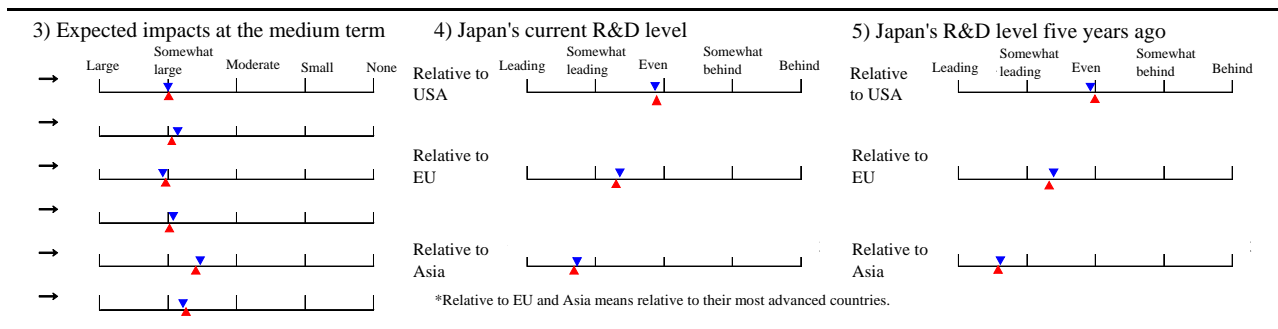
VII. Storage

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
High	Moderate	Low	
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets		
	Contribution to the development of other fields		
[Economic impacts]	Contribution to the development of existing Japanese industry		
	Contribution to the creation of new industries or businesses		
[Social impacts]	Contribution to safety and security		
	Contribution to improved social vitality and quality of life		

2. Questions regarding topics

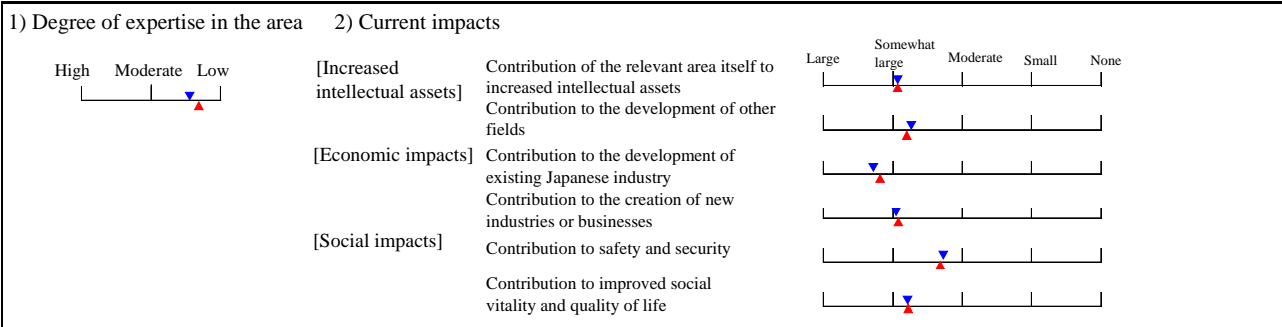
No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization									
			Respondents (persons)				Index					Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized		Do not know	
			High	Moderate	Low	None	High	Moderate	Low	None	(%)							(%)			
37	A storage system that stores a bit of data by using a single atom/molecule.	1	107	9	34	57	-	60	28	57	13	2								10	12
		2	103	5	18	77	-	54	14	74	12	0								9	5
		E	5	100	0	0	-	75	60	20	20	0								0	0
38	A magnetic hard disk drive that has a storage density of 10 terabits per square inch (an increase of more than two orders of magnitude from current technology).	1	112	4	28	68	-	74	52	41	6	1								5	9
		2	105	2	18	80	-	78	58	40	2	0								1	5
		E	2	100	0	0	-	75	50	50	0	0								0	0
39	An optical memory that has a storage density of 1 terabit or more per square inch (including the near field).	1	117	8	32	60	-	68	41	47	11	1								5	7
		2	100	5	29	66	-	63	31	62	6	1								3	4
		E	5	100	0	0	-	70	40	60	0	0								0	20
40	A large-scale probe array memory with a storage density of 10 terabits or more per square inch.	1	96	7	28	65	-	58	25	57	17	1								5	12
		2	91	3	24	73	-	51	11	71	18	0								3	7
		E	3	100	0	0	-	83	67	33	0	0								0	0



Countries at the leading edge	Regarding technological realization										Time of social application					Regarding social application																		
	Necessity of gov't involvement				Effective measures that should be taken by gov't						2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied		Do not know		Necessity of gov't involvement				Effective measures that should be taken by gov't										
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration						Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	(%)	(%)	(%)	(%)	(%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement
16	80	3	0	1	19	47	21	13	44	45	45	60	7	3	0	0						12	19	10	27	36	27	36	44	27	51	5	0	1
3	97	0	0	0	6	68	21	5	56	47	32	69	1	0	0	0						10	11	5	31	50	14	37	58	8	55	1	0	0
33	67	0	0	0	40	20	20	20	75	25	50	75	0	0	0	0						0	0	20	40	0	40	33	33	0	67	0	0	0
56	43	0	0	1	23	43	21	13	35	48	34	66	3	5	0	0						1	9	12	25	38	25	28	46	26	51	6	1	3
82	18	0	0	0	11	63	21	5	32	61	24	79	1	0	0	0						2	5	1	30	51	18	20	59	8	62	0	0	1
100	0	0	0	0	0	50	0	50	0	100	0	100	0	0	0	0						0	0	0	0	50	50	0	100	0	0	0	0	0
73	25	0	0	2	20	49	21	10	38	50	36	71	4	3	0	0						3	13	9	34	33	24	30	49	29	54	5	0	2
93	7	0	0	0	7	70	17	6	36	66	24	80	0	0	0	0						5	6	0	41	42	17	25	64	12	64	0	0	0
100	0	0	0	0	0	80	0	20	0	75	0	75	0	0	0	0						0	20	0	20	40	40	0	67	0	100	0	0	0
31	61	6	0	2	16	47	26	11	40	50	43	66	5	4	0	0						5	19	6	31	42	21	31	49	24	55	6	1	3
16	81	3	0	0	6	59	29	6	40	65	14	65	1	0	0	0						8	13	1	30	53	16	31	61	9	60	0	0	0
50	0	50	0	0	0	67	0	33	50	100	0	50	0	0	0	0						0	0	0	33	0	67	0	100	100	100	0	0	0

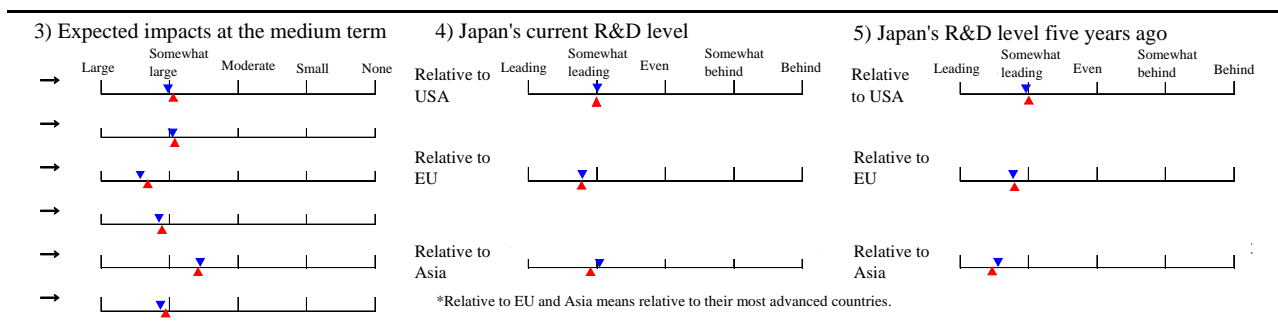
VIII. Displays

1. Questions regarding the relevant area



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan				Time of technological realization																					
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know													
				(%)				(%)				(%)																					
41	A flat-panel display larger than A3 size and with a resolution equivalent to high quality print images (600 dpi or higher).	1	123	11	32	57	-	70	45	46	7	2									2	117	6	28	66	-	71	43	53	4	0	0	0
		E	7	100	0	0	-	71	43	57	0	0									0	0	0	0	0	0	0	0					
42	A 3D video display that may be viewed without wearing special glasses and shows undistorted images even when the viewer makes certain natural movements such as shifting the body.	1	124	7	27	66	-	60	30	49	21	0									2	114	4	21	75	-	55	17	71	12	0	4	5
		E	5	100	0	0	-	70	40	60	0	0									0	0	0	0	0	0	0	0					
43	An organic emissive display that is so large as to cover an entire wall.	1	130	8	32	60	-	67	43	40	17	0									2	119	5	19	76	-	69	41	52	7	0	1	2
		E	6	100	0	0	-	83	67	33	0	0									0	0	0	0	0	0	0	0					
44	A display device that allows people to enjoy movies anywhere, anytime by directly projecting images on their retinas.	1	110	10	28	62	-	49	21	39	35	5									2	110	6	17	77	-	45	7	59	32	2	9	5
		E	7	100	0	0	-	50	14	57	29	0									0	0	0	0	0	0	0	0					
45	A folding display that is equivalent to newspaper in size, thickness, and resolution.	1	127	9	31	60	-	70	45	47	8	0									2	119	5	19	76	-	69	40	57	3	0	2	2
		E	6	100	0	0	-	83	67	33	0	0									0	0	0	0	0	0	0	0					



Countries at the leading edge	Regarding technological realization										Time of social application					Regarding social application													
	Necessity of gov't involvement				Effective measures that should be taken by gov't						Will not be applied		Do not know			Necessity of gov't involvement				Effective measures that should be taken by gov't									
Japan USA EU Asia Other	High Moderate Low None	Human resources development Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	High Moderate Low None	Human resources development Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other									
(%)	(%)	(%)											(%)	(%)	(%)														
86	7	0	7	0	20	36	28	16	29	49	35	68	10	6	1	0	2	5	12	29	31	28	30	48	29	54	8	1	1
98	0	1	1	0	3	59	31	7	22	58	23	79	2	3	1	0	0	1	3	32	44	21	18	52	11	72	3	0	0
100	0	0	0	0	0	14	43	43	33	67	33	67	0	0	0	0	0	0	0	17	33	50	33	67	33	67	0	0	0
66	29	3	0	2	11	36	38	15	37	47	32	63	9	5	2	1	4	7	7	26	40	27	34	47	41	45	12	5	1
84	14	2	0	0	5	50	36	9	33	62	21	72	3	0	1	0	4	5	3	24	58	15	24	55	25	56	1	3	1
100	0	0	0	0	40	0	40	20	0	33	33	100	0	0	0	0	0	0	25	25	25	25	0	33	33	67	0	0	0
80	17	3	0	0	21	37	23	19	29	52	38	77	9	4	0	1	2	3	10	27	32	31	29	46	35	58	13	1	1
96	3	1	0	0	6	60	26	8	22	65	24	78	1	1	0	0	0	1	2	30	50	18	16	55	18	71	5	0	0
80	20	0	0	0	17	49	17	17	25	75	25	75	0	0	0	0	0	0	20	40	20	20	25	100	25	75	25	0	0
31	64	3	0	2	11	41	33	15	29	50	34	56	8	15	13	1	9	10	8	38	33	21	29	41	35	36	21	19	4
10	90	0	0	0	2	57	30	11	33	67	21	61	0	10	3	0	6	6	2	41	39	18	22	52	30	50	23	9	0
0	100	0	0	0	0	29	42	29	0	50	0	50	0	25	0	0	0	0	17	17	33	33	0	25	50	75	50	0	0
64	30	6	0	0	17	48	19	16	31	58	40	72	7	6	1	0	2	3	8	36	29	27	25	52	34	56	13	2	1
84	15	1	0	0	8	65	20	7	26	68	26	73	0	1	0	0	0	1	6	39	36	19	19	64	21	67	3	0	0
80	20	0	0	0	0	66	17	17	40	80	20	80	0	20	0	0	0	0	17	33	17	33	50	75	25	75	25	0	0

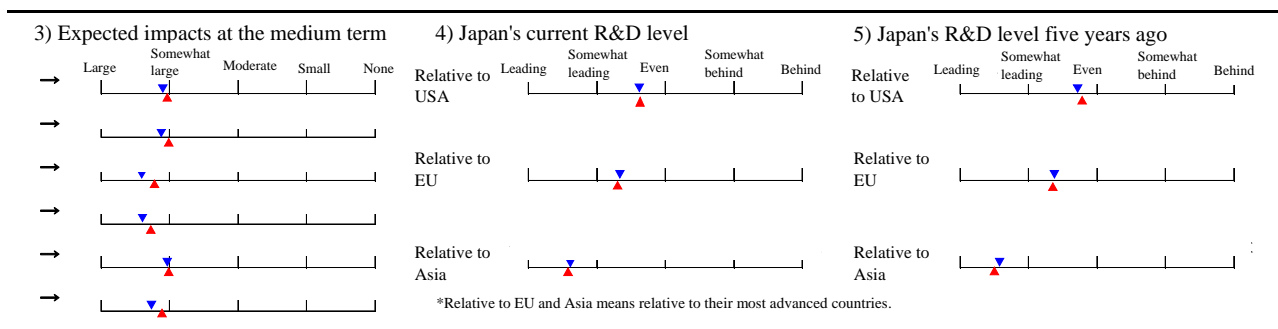
IX. Energy conversion/storage devices

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
High	Moderate	Low	
		[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets
			Contribution to the development of other fields
		[Economic impacts]	Contribution to the development of existing Japanese industry
			Contribution to the creation of new industries or businesses
		[Social impacts]	Contribution to safety and security
			Contribution to improved social vitality and quality of life

2. Questions regarding topics

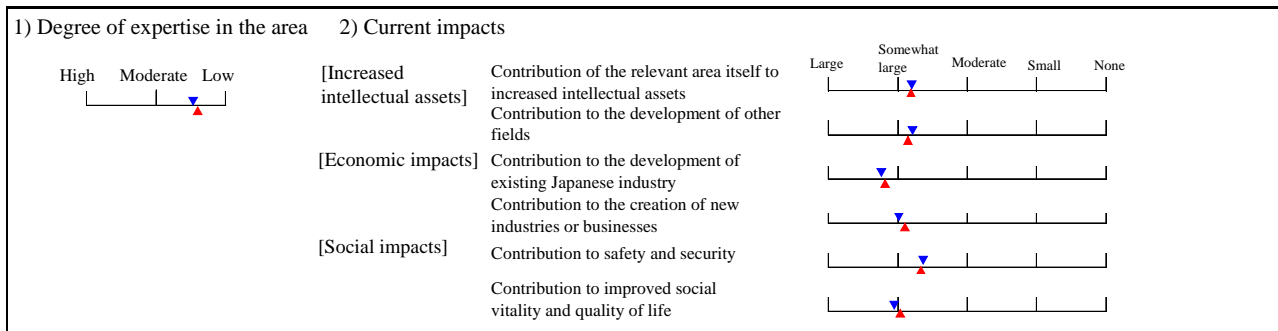
No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization										
			Respondents (persons)				Index					Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know			
			High	Moderate	Low	None	High	Moderate	Low	None							(%)	(%)				
46	The batteries of most mobile equipment (PCs, mobile phones, PDAs, etc.) are replaced by fuel cells.	1	127	6	28	66	-	78	58	37	4	1								2	1	
		2	114	4	18	78	-	83	69	27	4	0								1	2	
		E	4	100	0	0	-	69	50	25	25	0								0	25	
47	A new material that offers a higher energy conversion efficiency than silicon or GaAs solar cells.	1	113	8	35	57	-	75	53	41	6	0									4	17
		2	108	8	24	68	-	82	65	30	5	0									4	3
		E	9	100	0	0	-	83	67	33	0	0									0	0
48	A miniature electric generator that uses thermal or vibration energy and may be embedded in IC tags.	1	117	5	35	60	-	67	39	51	9	1									2	5
		2	110	4	17	79	-	64	31	62	7	0									0	2
		E	4	100	0	0	-	69	50	25	25	0									0	0



Countries at the leading edge		Regarding technological realization											Time of social application					Regarding social application																	
		Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't													
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	
(%)					(%)				(%)							(%)					(%)				(%)										
70	26	4	0	0	25	42	22	11	28	50	34	61	8	30	6	0							2	5	25	40	20	15	20	40	31	48	50	16	1
91	9	0	0	0	8	72	15	5	23	71	22	76	4	23	1	0							2	3	7	54	29	10	17	42	17	58	56	4	1
100	0	0	0	0	25	50	0	25	0	100	33	100	0	33	0	0							0	25	25	25	25	25	0	33	33	33	100	0	0
54	40	5	0	1	27	44	23	6	32	53	36	61	7	8	2	0							3	21	21	39	24	16	21	50	23	57	21	12	2
77	23	0	0	0	12	71	11	6	37	70	23	80	0	3	0	0							5	4	7	63	20	10	23	55	18	72	15	6	1
62	38	0	0	0	22	67	0	11	63	63	25	88	0	38	0	0							0	0	11	67	11	11	38	50	38	88	38	25	0
51	46	3	0	0	20	46	27	7	41	52	38	62	6	9	1	0							3	8	15	37	32	16	28	47	36	48	22	9	1
62	37	1	0	0	10	66	18	6	43	68	20	75	0	5	2	0							0	3	6	48	33	13	21	57	32	61	16	4	1
100	0	0	0	0	50	25	0	25	67	67	0	100	0	0	0	0							0	0	25	50	0	25	0	67	67	100	33	0	0

X. Digital home appliances

1. Questions regarding the relevant area



2. Questions regarding topics

No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization									
			Respondents (persons)				Index					Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know		
			High	Moderate	Low	None	Index	High	Moderate	Low	None							(%)			
49	LSI that enables comprehensive media processing on a chip not simply by storing, communicating or signal-processing, but also by providing understanding and retrieval functions of audiovisual content.	1	116	9	45	46	-	68	41	49	9	1							0	3	
		2	112	5	32	63	-	60	23	72	4	1								2	1
		E	6	100	0	0	-	54	33	33	17	17								20	0
50	A high-resolution video distribution system that allows searching through and distribution of TV, film, and music archives of the past few years.	1	117	6	36	58	-	57	30	39	30	1							1	3	
		2	109	6	17	77	-	48	9	65	26	0							0	1	
		E	6	100	0	0	-	54	17	66	17	0							0	0	
51	Wall-mounted panels and furnishings with communications, sensing, displaying, lighting and other capabilities.	1	124	7	31	62	-	55	24	50	24	2							1	1	
		2	112	4	18	78	-	50	11	68	21	0							0	1	
		E	4	100	0	0	-	58	34	33	33	0							0	0	
52	Fully wireless office and home environments that obviate the need for the physical connection.	1	135	13	37	50	-	61	31	53	14	2							4	2	
		2	116	9	23	68	-	55	16	73	11	0							3	0	
		E	11	100	0	0	-	64	36	46	18	0							10	0	

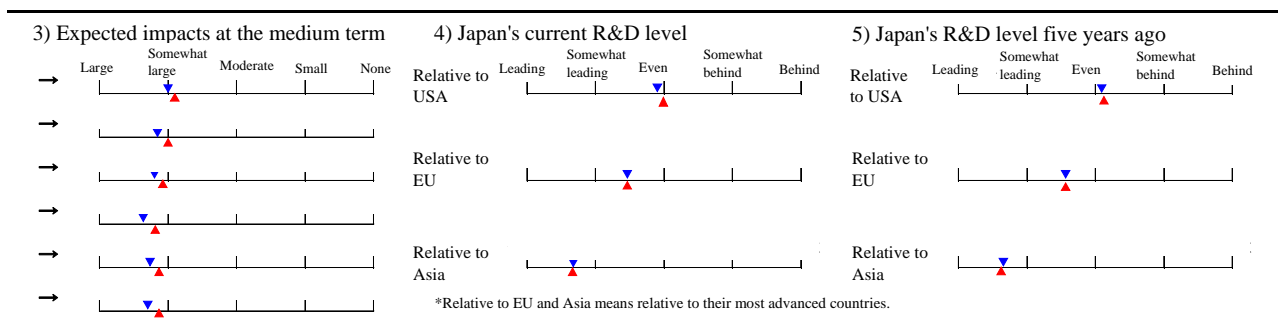
XI. Ubiquitous electronics

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
High	Moderate	Low	
[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets		
	Contribution to the development of other fields		
[Economic impacts]	Contribution to the development of existing Japanese industry		
	Contribution to the creation of new industries or businesses		
[Social impacts]	Contribution to safety and security		
	Contribution to improved social vitality and quality of life		

2. Questions regarding topics

No	Topic	Questionnaire	Degree of expertise				Importance to Japan					Time of technological realization										
			Respondents (persons)				Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know			
			High	Moderate	Low	None														(%)	(%)	(%)
53	A one-chip ubiquitous computer with which information can be exchanged anytime, anywhere, and with anyone.	1	130	11	33	56	-	72	48	43	8	1								2	1	
		2	115	7	24	69	-	77	58	36	6	0									1	0
		E	8	100	0	0	-	84	74	13	13	0									0	0
54	RF tags for attaching to most everyday items to help to track their location and state.	1	146	9	39	52	-	74	53	40	6	1								1	0	
		2	129	7	29	64	-	80	63	32	5	0									1	0
		E	9	100	0	0	-	94	89	11	0	0									0	0
55	A system that provides information services most suited for the users and their situation without instructions from them.	1	117	7	28	65	-	58	29	47	21	3								3	3	
		2	104	2	18	80	-	54	15	71	14	0									3	2
		E	2	100	0	0	-	75	50	50	0	0									0	0



Countries at the leading edge	Regarding technological realization													Time of social application					Regarding social application																
	Necessity of gov't involvement				Effective measures that should be taken by gov't									Will not be applied	Do not know	Necessity of gov't involvement				Effective measures that should be taken by gov't															
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities			Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	
(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)			
33	65	1	0	1	28	39	20	13	38	55	32	76	19	15	5	1							3	3	21	30	31	18	32	46	31	44	37	14	1
15	83	2	0	0	12	61	18	9	36	73	23	72	3	5	1	0							0	2	5	51	33	11	25	58	11	61	35	2	0
43	57	0	0	0	14	43	14	29	0	100	20	80	0	20	20	0							0	0	0	42	29	29	0	60	20	40	40	20	0
62	37	1	0	0	29	39	19	13	26	47	30	52	35	37	18	2							1	1	31	38	21	10	23	38	26	43	61	32	2
88	12	0	0	0	17	56	19	8	21	59	15	63	19	33	8	0							0	1	15	57	22	6	16	37	12	51	68	21	0
75	25	0	0	0	37	38	25	0	0	88	13	50	0	50	13	0							0	0	13	62	25	0	0	50	25	38	63	25	0
29	68	1	0	2	16	39	27	18	31	49	29	54	15	17	11	0							2	4	17	34	30	19	26	37	33	40	40	25	0
10	90	0	0	0	6	53	31	10	27	63	10	75	3	9	0	0							1	3	4	47	41	8	18	47	16	60	36	13	0
100	0	0	0	0	0	50	50	0	0	50	50	100	0	0	0	0							0	0	50	0	50	0	0	50	50	100	50	50	0

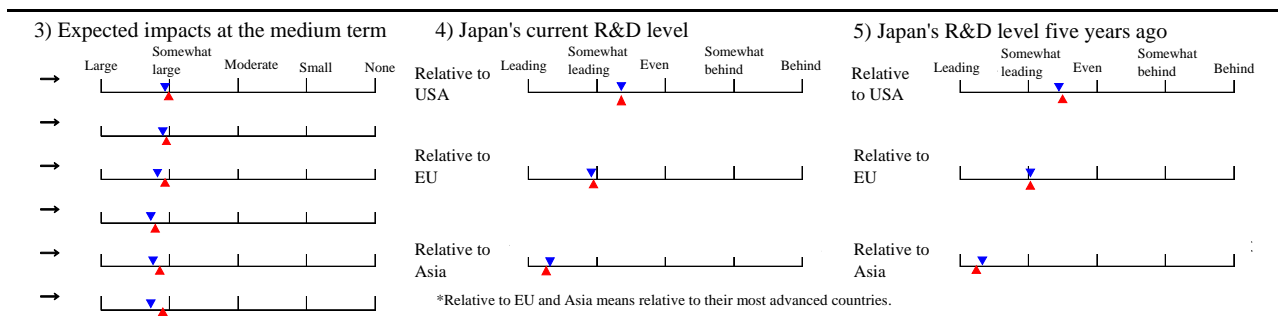
XII. Robot electronics

1. Questions regarding the relevant area

1) Degree of expertise in the area	2) Current impacts		
<p>High Moderate Low</p>	[Increased intellectual assets]	Contribution of the relevant area itself to increased intellectual assets	
		Contribution to the development of other fields	
	[Economic impacts]	Contribution to the development of existing Japanese industry	
		Contribution to the creation of new industries or businesses	
	[Social impacts]	Contribution to safety and security	
		Contribution to improved social vitality and quality of life	

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization								
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
				(%)				(%)					(%)								
56	It becomes popular that every family has a household helper robot capable of doing the washing, cleaning,, and other household chores.	1	122	7	18	75	-	57	26	51	20	3								3	4
		2	117	3	14	83	-	53	14	70	16	0								1	3
		E	4	100	0	0	-	38	0	50	50	0								0	0
57	A microrobot that contains sensors, controllers, and actuators tightly packed using micromachine technology and can be sent into the human body for medical examination.	1	122	10	27	63	-	67	38	53	9	0								2	7
		2	116	6	16	78	-	61	23	72	5	0								2	2
		E	7	100	0	0	-	75	57	29	14	0								0	0
58	Surgery performed by remotely controlling a micromachine equipped with sensors and manipulators.	1	110	7	25	68	-	63	36	46	16	2								3	6
		2	110	4	15	81	-	59	23	68	9	0								2	1
		E	4	100	0	0	-	81	75	0	25	0								0	0



Countries at the leading edge						Regarding technological realization										Time of social application						Regarding social application													
						Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't									
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	
(%)						(%)				(%)						(%)						(%)													
85	14	0	0	1	16	31	31	22	34	56	29	54	8	17	6	1							4	4	11	34	31	24	27	38	31	43	33	20	1
97	3	0	0	0	5	49	37	9	32	63	19	59	4	7	1	1							3	4	4	45	36	15	20	36	18	63	36	14	0
100	0	0	0	0	0	25	50	25	0	33	33	67	0	0	0	0							25	0	0	0	50	50	0	50	50	50	0	0	0
33	63	4	0	0	32	43	14	11	46	53	50	65	7	26	6	0							1	8	27	44	18	11	36	41	25	42	53	29	1
12	88	0	0	0	17	63	15	5	52	65	34	72	1	21	6	0							0	4	14	65	16	5	36	50	20	51	69	19	0
17	83	0	0	0	43	43	0	14	83	83	67	83	0	0	0	0							0	0	43	43	0	14	83	83	67	67	50	17	0
30	66	3	0	1	30	44	16	10	46	55	43	65	8	26	11	1							1	7	33	40	17	10	36	44	20	39	56	31	1
14	85	1	0	0	13	65	17	5	49	68	27	70	0	23	5	0							1	3	16	62	16	6	37	55	14	49	69	18	0
33	67	0	0	0	50	25	0	25	67	67	33	67	0	33	0	0							0	0	50	25	0	25	67	67	33	67	67	0	0

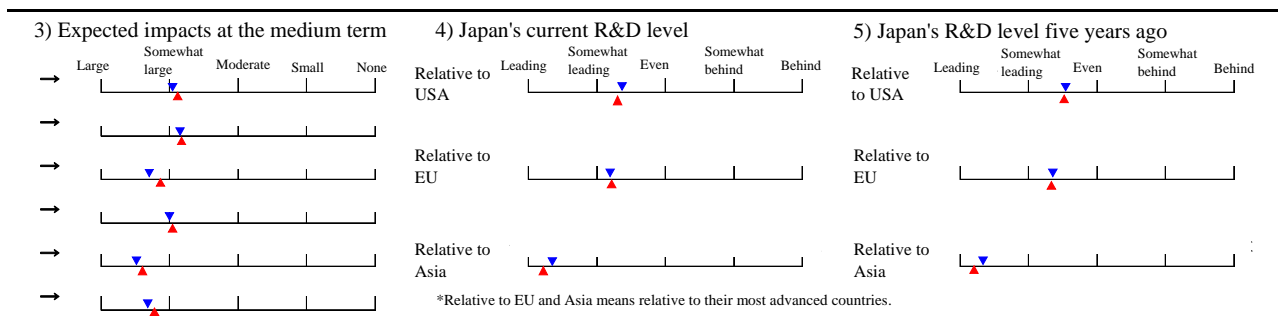
XIII. Car electronics

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
	[Increased intellectual assets] Contribution of the relevant area itself to increased intellectual assets Contribution to the development of other fields [Economic impacts] Contribution to the development of existing Japanese industry Contribution to the creation of new industries or businesses [Social impacts] Contribution to safety and security Contribution to improved social vitality and quality of life		

2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan					Time of technological realization								
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
				(%)				(%)					(%)								
59	A system that automatically drives a car to the specified destination.	1	108	6	28	66	-	59	32	42	23	3								5	6
		2	111	4	14	82	-	52	14	68	18	0								5	2
		E	4	100	0	0	-	63	25	75	0	0									0
60	An automotive system in which a car is equipped with sensors for predicting and diagnosing failures and accidents.	1	120	7	34	59	-	73	47	49	4	0								1	2
		2	114	4	22	74	-	70	43	51	6	0								0	1
		E	5	100	0	0	-	65	40	40	20	0									0
61	Technology to allow 100-Mbps or faster communications between cars or between a car and a base station.	1	113	5	42	53	-	59	29	48	23	0								0	3
		2	113	5	27	68	-	56	16	76	8	0								0	0
		E	6	100	0	0	-	79	66	17	17	0									0



Countries at the leading edge						Regarding technological realization										Time of social application						Regarding social application														
						Necessity of gov't involvement				Effective measures that should be taken by gov't												Necessity of gov't involvement				Effective measures that should be taken by gov't										
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other		
(%)						(%)				(%)						(%)						(%)														
61	35	4	0	0	24	43	21	12	27	51	40	46	11	45	20	1								9	9	34	35	17	14	25	36	16	34	59	40	2
83	17	0	0	0	5	64	23	8	22	64	31	58	1	43	9	0								6	7	20	53	21	6	16	38	7	43	77	34	0
33	67	0	0	0	0	75	25	0	50	50	50	50	0	75	25	0								0	0	0	50	25	25	33	67	33	67	100	33	0
76	18	6	0	0	20	42	28	10	24	49	38	55	13	27	9	1								0	4	21	39	26	14	19	43	17	46	50	23	0
92	7	1	0	0	4	60	25	11	19	68	20	63	1	24	5	0								0	2	6	56	28	10	15	45	5	56	70	17	0
50	50	0	0	0	20	20	40	20	25	100	25	50	0	50	0	0								0	0	20	20	20	40	33	100	33	67	100	67	0
55	41	4	0	0	17	41	29	13	20	43	32	53	14	39	16	0								0	3	20	39	26	15	14	37	14	38	60	23	1
78	21	1	0	0	6	68	22	4	17	60	21	62	0	31	5	0								0	1	7	58	29	6	13	42	6	42	76	9	0
40	40	20	0	0	33	50	0	17	40	60	60	60	0	40	0	0								0	0	17	66	0	17	40	60	40	80	60	20	0

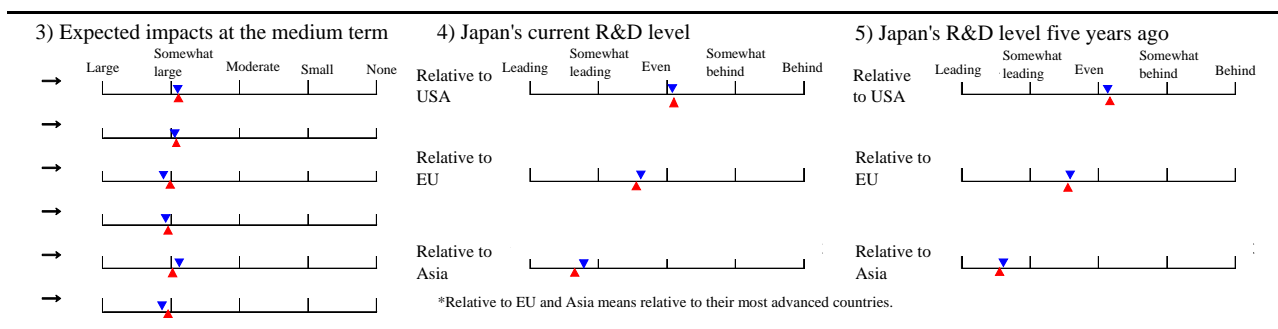
XIV. Network electronics

1. Questions regarding the relevant area

1) Degree of expertise in the area		2) Current impacts	
<p>High Moderate Low</p>	<p>[Increased intellectual assets] Contribution of the relevant area itself to increased intellectual assets</p> <p>[Economic impacts] Contribution to the development of existing Japanese industry</p> <p>[Social impacts] Contribution to safety and security</p> <p>Contribution to improved social vitality and quality of life</p>	<p>Contribution to the development of other fields</p> <p>Contribution to the creation of new industries or businesses</p>	<p>Large Somewhat large Moderate Small None</p>

2. Questions regarding topics

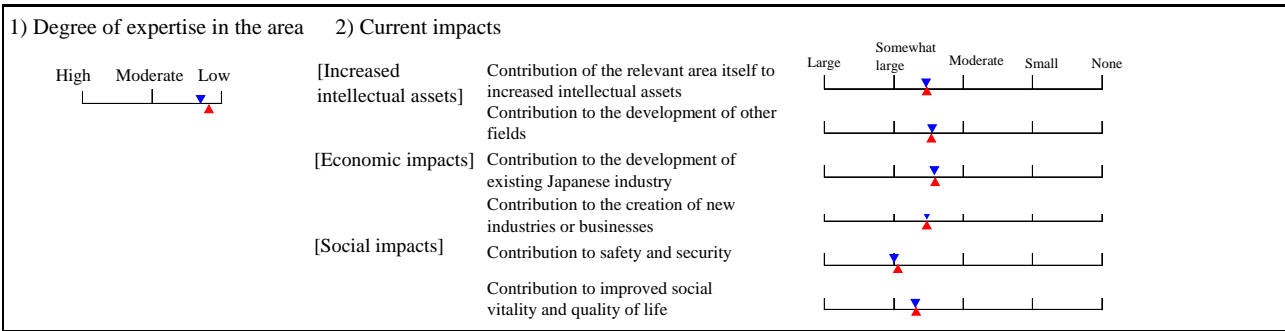
No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan				Time of technological realization									
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know	
				(%)				(%)				(%)									
62	Technology with which HDTV video (about 1.5 Gbps) can be transmitted to any remote place without delays due to compression and other processing.	1	102	12	31	57	-	59	25	65	8	2								1	2
		2	106	8	23	69	-	54	12	82	6	0								1	1
		E	8	100	0	0	-	59	25	62	13	0									0
63	Technology for time division transmission at 100 Gbps or faster.	1	99	16	37	47	-	64	34	55	10	1								1	2
		2	100	12	23	65	-	55	13	81	6	0								1	1
		E	12	100	0	0	-	69	42	50	8	0									0
64	Large-scale (about 1000x1000) optical cross-connect equipment	1	100	19	35	46	-	65	35	56	8	1								1	4
		2	97	13	28	59	-	56	16	76	8	0								0	3
		E	13	100	0	0	-	71	46	46	8	0									0



Countries at the leading edge						Regarding technological realization										Time of social application					Regarding social application														
						Necessity of gov't involvement				Effective measures that should be taken by gov't											Necessity of gov't involvement				Effective measures that should be taken by gov't										
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied	Do not know	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement	Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	
(%)						(%)				(%)						(%)					(%)				(%)										
58	42	0	0	0	19	36	27	18	28	51	32	57	10	16	1	0							3	4	13	36	35	16	22	40	21	49	40	10	0
73	27	0	0	0	3	67	24	6	21	61	21	70	6	13	1	0							1	1	2	51	37	10	16	48	10	66	50	3	0
100	0	0	0	0	0	37	38	25	17	50	33	50	17	0	0	0							0	0	0	13	62	25	17	17	17	67	33	0	0
62	36	2	0	0	22	39	21	18	32	50	33	68	6	6	0	0							0	5	11	39	31	19	22	46	17	65	19	4	0
82	18	0	0	0	5	70	20	5	27	63	18	78	2	7	0	0							0	3	3	59	29	9	18	55	8	78	14	1	0
91	9	0	0	0	8	76	8	8	36	64	27	91	0	9	0	0							0	8	0	67	25	8	18	64	18	91	18	0	0
38	60	1	0	1	25	38	24	13	31	49	37	69	8	6	0	0							0	5	15	35	32	18	27	46	22	55	18	1	0
19	80	0	1	0	7	68	19	6	27	65	22	79	1	3	0	0							0	4	4	49	33	14	22	59	7	80	12	1	0
33	67	0	0	0	31	53	8	8	25	75	25	92	0	0	0	0							0	0	17	50	25	8	9	64	9	82	9	0	0

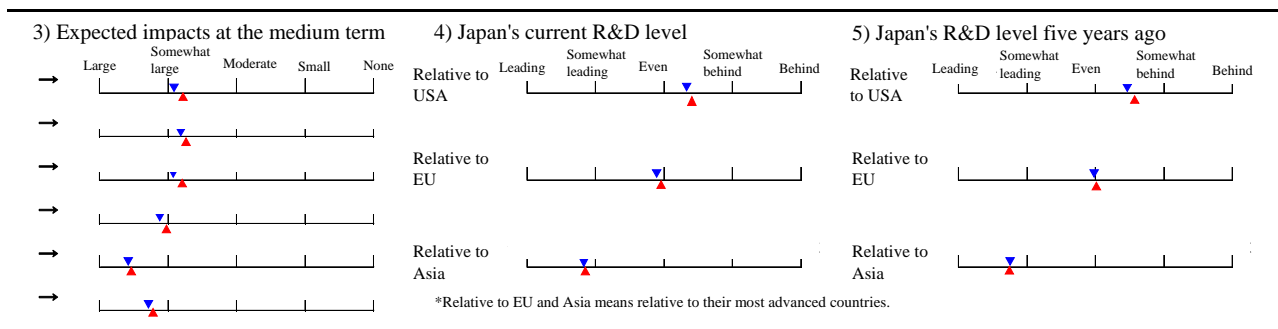
XV. Security electronics

1. Questions regarding the relevant area



2. Questions regarding topics

No	Topic	Questionnaire	Respondents (persons)	Degree of expertise				Importance to Japan				Time of technological realization								
				High	Moderate	Low	None	Index	High	Moderate	Low	None	Already realized	2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be realized	Do not know
				(%)				(%)				(%)								
65	A biometric authentication system capable of non-contact, high-accuracy identification of individuals from a distance of about 10 m (with an authentication performance equivalent to the current fingerprint authentication systems and for potential applications such as quick access control without slowing the flow of people walking along the passage).	1	98	7	30	63	-	56	26	52	19	3							1	5
		2	95	1	15	84	-	55	13	80	7	0							0	1
		E	1	100	0	0	-	100	100	0	0	0								0
66	Widespread use of portable authentication technologies that can quickly authenticate individuals based on their DNA.	1	87	6	25	69	-	57	28	47	21	4							2	11
		2	94	1	11	88	-	52	10	79	11	0							2	2
		E	1	100	0	0	-	50	0	100	0	0							0	0
67	Non-contact detectors for drugs, toxic gases, biological weapons, etc.	1	86	5	30	65	-	67	41	46	11	2							2	12
		2	91	1	14	85	-	62	28	65	6	1							1	7
		E	1	100	0	0	-	100	100	0	0	0							0	0
68	A crustal movement sensor that enables prediction of an earthquake a few minutes before it occurs.	1	86	3	26	71	-	86	75	22	1	2							6	18
		2	90	0	12	88	-	93	86	13	1	0							8	7
		E																		
69	Widespread use of tracing systems (for food, recycled goods, etc.) in which the information stored in the electronic tags attached to food and other merchandise is linked to logistics, POS systems, and home-delivery services.	1	113	7	31	62	-	69	42	49	8	1							0	2
		2	109	2	13	85	-	63	28	68	4	0							0	0
		E	2	100	0	0	-	63	50	0	50	0							0	0



Countries at the leading edge	Regarding technological realization													Time of social application					Regarding social application															
	Necessity of gov't involvement				Effective measures that should be taken by gov't									2006-2010	2011-2015	2016-2025	2026-2035	2036-	Will not be applied		Do not know		Necessity of gov't involvement				Effective measures that should be taken by gov't							
Japan	USA	EU	Asia	Other	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Development of R&D infrastructure	Expansion of R&D funding	Internationalization of R&D activities						Relaxation or elimination of relevant regulations	Tightened or new regulations	Other	(%)	(%)	(%)	(%)	(%)	High	Moderate	Low	None	Human resources development	Strengthened industry-academic-government and interdisciplinary collaboration	Improvement of environment for business startups	Support through taxation, subsidies, and procurement
	16	80	1	1	2	18	52	17	13	32	44	38	53	16	19	12	0					2	5	23	41	25	11	22	34	20	48	33	40	1
	4	96	0	0	0	5	76	15	4	37	62	31	73	3	15	4	0					0	2	11	65	19	5	21	51	13	68	30	37	0
	100	0	0	0	0	0	100	0	0	0	0	0	100	0	0	0	0					0	0	100	0	0	0	0	0	0	100	0	0	0
	1	96	3	0	0	28	40	18	14	46	46	37	59	10	21	18	0					2	12	28	30	27	15	24	36	18	44	36	36	2
	0	100	0	0	0	8	76	12	4	51	69	22	74	3	15	8	0					1	8	21	61	14	4	23	46	8	67	39	47	0
	0	100	0	0	0	100	0	0	0	0	100	0	0	100	100	0	0					0	0	100	0	0	0	0	0	0	100	100	100	0
	4	96	0	0	0	39	40	13	8	36	45	41	69	15	12	12	0					1	11	40	33	17	10	30	45	16	48	17	25	1
	1	99	0	0	0	31	55	9	5	38	61	31	80	6	8	7	0					0	5	41	41	13	5	30	60	7	78	14	23	0
	0	100	0	0	0	100	0	0	0	0	0	0	100	0	100	100	0					0	0	100	0	0	0	0	0	0	0	100	100	0
	85	12	0	0	3	64	25	5	6	45	47	58	55	7	4	1	0					5	21	61	22	9	8	38	49	21	55	8	8	3
	98	2	0	0	0	84	10	3	3	52	58	58	76	1	4	0	0					7	7	78	17	0	5	42	73	7	77	6	6	0
	53	43	4	0	0	30	43	15	12	28	55	31	48	18	25	19	0					0	5	35	36	18	11	20	41	24	42	38	43	1
	82	18	0	0	0	16	63	15	6	22	68	17	59	10	20	13	0					0	1	31	48	15	6	16	60	14	63	42	48	0
	100	0	0	0	0	50	0	50	0	0	0	0	100	0	0	0	0					0	0	0	50	0	50	0	0	0	0	0	100	0