

# Information Technology Engineers Skill Standards

## IT Common Body of Knowledge

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## 1. Overview

### 1.1 Background of developing the “Information Technology Engineers Skill Standards”

At present, great hopes are placed on information technology as the sources of industry regeneration and new economic growth. This is because the roles of IT have been expanded from the tools for manufacturing cost reduction and service speedup to those for effective collaboration among enterprises and the creation of new industries. From now on, the rise or fall of an enterprise will be determined by quality of computerization investment. It is therefore an urgent matter to bring up engineers who construct advanced information systems and those who utilize them.

In view of this, the Central Academy of Information Technology has repeated a study on how to bring up, evaluate, and select good engineers who can show their practical ability on actual jobs. As a conclusion, the academy decided to establish the “information technology engineers skill standards” centering on the criteria to determine whether the required jobs can be performed adequately or not.

### 1.2 Significance and objective of developing the “Information Technology Engineers Skill Standards”

The results of surveys that the Central Academy of Information Technology has conducted on information processing engineers have suggested an important issue to be solved in the industrial world and by educational institutions such as schools. The issue is the establishment of the guidelines that clearly define **the level of knowledge, skills and capability that the industrial and educational worlds are expecting IT personnel (engineers) to be equipped with or acquire.**

While these guidelines need to define the level of knowledge, skills and capability to be equipped with by IT personnel (engineers) who do the actual jobs in the industrial world, they need to define the models of IT engineers who can be accepted internationally, and the ways how schools and other educational institutions should conduct education training on the basis of these models.

One example of the guidelines is the “Skill Standard for IT Engineers” developed by the Northwest Center for Emerging Technologies (NWCET) as part of the establishment of “Skill Standards” by the US Department of Labor.

The “Information Technology Engineers Skill Standards” have been developed as a tool that solves the issue mentioned above, and apply to all the sections of the information technology engineers examinations as criteria to evaluate the skills of engineers who have been brought up. The application of this skill standard **will be** significant for the industrial world in “recruiting human resources with the guaranteed ability to do actual jobs.” For educational institutions such as schools, this **will be** significant for “understanding and confirming the knowledge, ability, and the achievement levels of the engineers required by enterprises.” For government agencies, this **will be** significant for “grasping the technical level of the entire industrial world.”

### 1.3 What is the IT common body of knowledge?

The “IT common body of knowledge (CBOK)” shows structurally the knowledge which is commonly evaluated in all categories (applicable persons) in information technology engineers examinations. Reflecting the knowledge shown in the “Information Technology Engineers Examinations: Scope of Examinations”, this CBOK has been produced by extracting and arranging these elements which are often made use of on the actual jobs in the development of information systems, and which are effective to be taken up as study items in information processing education and training.

#### (1) Structure

The IT common body of knowledge has the structure shown below:

Knowledge field	Major classification	Intermediate classification	Major technical item
Knowledge field No. and name	Major classification No. and name		
		Intermediate classification No. and name	Items 1, 2 and 3
			Items 4, 5 and 6
			Items 7 and 8
	Major classification No. and name		
		Intermediate classification No. and name	Items 1, 2 and 3
			Items 4, 5
		Major classification No. and name	
Intermediate classification No. and name		Items 1, 2 and 3	
		Item 4	
	Intermediate classification No. and name	Items 1, 2 and 3	
		Items 4, 5 and 6	

Note: Knowledge field: I to VIII  
 Major classification: A serial No. starting with 1 in each knowledge field  
 Intermediate classification: A relative No. starting with 1 appended to the major classification No.

- 1) The “knowledge field” basically corresponds to “Test in the morning: Field.” However, the “security and standardization” in the examination is divided into “security” and “standardization,” and so there are eight knowledge fields in total.
- 2) “Major classifications” and “intermediate classifications” are sorted and arranged in such a way as to conform to the classification shown in “information technology engineers examinations – scope of examination.”
- 3) “Major technical items” are technical items extracted as typically taken up in the intermediate classifications.

#### (2) Technical level

The examination in the morning gives questions on knowledge at the technical level shown in the “table of questions classified by examination categories”. In the CBOK each knowledge field includes technical items up to level II except that Knowledge field, “I. Computer science fundamentals” contain Level III technical items. For items of technical level III in knowledge fields not described above, refer to the “practical body of knowledge and core body of knowledge” in the examination categories.

#### (3) Changes in the system and technical levels

The rapidness of information technology innovation affect intermediate classifications in mid-term, and technical items in short term in their themes and their priorities. This will cause changes to the contents of the ITBOK depending on the trend of computing technologies, network technologies, database technologies, object-oriented technologies, and so on.

- (4) Applicants in each examination category will be given questions on the knowledge fields marked in its category column and at the technical level indicated with the marks.

Table 1: “Examination in the morning: Table of questions classified by examination categories”

Examination category  Field	Application systems engineer Project manager Systems analyst	Software design & development engineer	Technical engineer				Information systems security administrator	Senior systems administrator	Systems administrator	Systems auditor	Fundamental information technology engineer
			Network	Database	Systems management	Embedded systems					
Computer science fundamentals		○ III									○ II
Computer system	○ II	○ II	⊙ II	○ II	⊙ II	⊙ III	○ II	○ II	○ I	○ II	○ I
System development and operation	⊙ III	○ II	○ II	○ II	⊙ III	○ II	○ I	⊙ II	○ I	○ II	○ I
Network technology		○ II	⊙ III		○ II	○ II	○ II				○ I
Database technology		○ II		⊙ III	○ II						○ I
Security and standardization	○ II	○ II	○ III	○ II	○ II	○ II	⊙ III	○ II	○ I	○ III	○ I
Computerization and management	⊙ III						○ II	⊙ III	⊙ I	⊙ II	○ I
Audit							○ II			⊙ III	

Notes:

- A field marked with a circle “○” is included in the scope of the examination in the particular category, and a field marked with a double circle “⊙” is an important field in the scope of the examination.
- Technical levels are marked with I, II and III. Level III is the most advanced and covers level II and I, and level II covers level I.

## 2. IT Common Body of Knowledge

(MVS, UNIX, LINUX, Windows, MacOS, and Java are the trademarks of their manufacturers, vendors or organizations.)

Knowledge field	Major classification	Intermediate classification	Major technical item
I. Computer science fundamentals			
	1. Basic theories of information		
	1.1	Numeric conversion and data representation	Radix conversion, numeric representation (including complement representation and fractional number representation), non-numeric value representation (character representation, voice representation, and image representation), operation and precision (single precision, double precision, fixed point precision, floating point precision, shift operation, overflow and underflow)
	1.2	Information and logic	Logical operation (true, false, logical product, logical sum, negation, exclusive OR, negative AND, and De Morgan theorem), proposition logic, logic function, information logic and coding theory (channel coding, source coding, encryption, decoding, Humming code, Huffman code, CRC, parity check), predicate logic (deduction and induction, inference), automaton (finite automaton, Turing machine, state transition), formal language (definition, operation, type and grammar, <b>Chomsky's production rule</b> , BNF, Polish notation, <b>regular expression</b> , <b>syntax-directed transfer method</b> , attribute context-free grammar, context-free language), graph theory (directed/non-directed graph, Eulerian graph), computational complexity (large O notation), information content (entropy), correctness theory (partial correctness, termination, full correctness)
	1.3	Mathematical applications	Numeric calculation (matrix and determinant, approximate solution, and interpolation), probability and statistics (permutation, combination, probability, addition and multiplication theorem, probability distribution, expectation, Markov process, estimation, testing, regression analysis), optimization problem (linear programming method, PERT, shortest path problem, and queuing theory)
	2. Data structures and algorithms		
	2.1	Data structures	Arrays (dimension, static arrays and dynamic arrays), lists (linear list, uni-directional list, bi-directional list, ring list, linked list), stacks (LIFO, push and pop), queue (FIFO, enqueue and dequeue), trees (binary tree, balanced tree, ordered tree, multiway tree, search tree, heap), hash (calculation of storage location, and collision handling)
	2.2	Algorithms	Various <b>algorithms</b> ( <b>searching</b> , <b>sorting</b> , recursive algorithm, genetic algorithm, approximate algorithm, probability algorithm, natural language processing algorithm, language processor, linkage editor, memory management, data compression algorithm, collation, file processing, character string processing, graph, numeric calculation, and algorithms related to diagrams), relationships between algorithm and data structure, algorithm efficiency, algorithm design method, flowchart, and decision table

Knowledge field	Major classification	Intermediate classification	Major technical item
II. Computer system			
1. Hardware			
	1.1	Information element	Semiconductor (CMOS, bipolar, SRAM, DRAM, SDRAM, and flash memory), integrated circuit
	1.2	Processor architecture	Processor structure and operation principle (register, address assignment mode, instruction set, instruction execution control, interruption control, microprogramming control, CISC/RISC), high-speed system (pipeline and parallel system),  operation mechanism (logical circuit, adder, and sequence circuit), multiprocessor (tight coupling, array, tandem, loose coupling, synchronization, VLIW, super scalar), processor performance (MIPS, clock, and CPI)
	1.3	Memory architecture	Memory cache, memory capacity and performance, types of memory,  memory configuration (interleave, memory parity, ECC, layers of memory, memory protection system, and high-speed access to main memory)
	1.4	Auxiliary memory	Storage media (semiconductor, magnetic disk, magnetic tape, magneto-optical disc, and optical disk), types and characteristics of auxiliary storage devices (HD, MO, CD, DVD, MT, etc., and access speed, volatility, types and characteristics of RAID (RAID0, RAID1, RAID2, RAID3, RAID4, and RAID5)), performance and capacity calculation of auxiliary storage devices (capacity, access time, blocking factor, and defragmentation)
	1.5	Input/output architecture and equipment	Input/output interface (bus, DMA, channel, SCSI, Centronics, GPIB, RS-232C, USB, IEEE1394, Ir-DATA, input/output control system, and channel control system),  types and characteristics of input/output devices (keyboard, pointing device, display, printer, various types of auxiliary storage devices, etc.), types and characteristics of communication control devices (modem, DCE, TA, DSU, CCU, FDM, TDM, repeater, router, bridge, gateway, hub, and cable), connection methods and connection media of input/output devices and communication equipment (serial connection, parallel connection, types and characteristics of connection cable, and communication media)
	1.6	Types of computers, and characteristics of architecture	Personal computer, workstation, general-purpose computer, supercomputer, control computer, and microcomputer
	1.7	Embedded systems	Component parts and construction (processor, DSP, sensor, memory, ASIC, PWM, D/A, A/D), logical design (processor, bus, circuit design, and timing design), and control theory (feedback and open loop), EMI, and Co-Design

Knowledge field	Major classification	Intermediate classification	Major technical item
	2. Basic software	2.1 Operating System	OS configuration and functions, process management (exclusive control, semaphore, state transition, preemption, round robin, execution control, deadlock), kernel and interruption control, main memory control (memory protection, dynamic link allocation, fragmentation, memory leak), virtual storage (paging algorithm, slashing, and DAT), input/output control, spooling function, file management function (exclusive control, recovery processing, directory, file organization (sequential organization, partitioned organization, indexed sequential organization, random organization), access methods (BSAM, ISAM, VSAM), program control and system call, job management (job scheduling, JCL), real-time processing, TSS, security control, fault management, data management (access authorization), multiple programming (execution order, simple execution time), Japanese language processing, multimedia processing, human interface, types of OS (MVS, UNIX, Linux, Windows, MacOS, free software OS)
		2.2 Network OS	Functions and features of network OS, network management (SNMP), network control (types and features of protocol)
		2.3 Embedded OS	Real-time OS, device driver, theory and algorithm of parallel and distributed calculation (Petri-net)
		2.4 Middleware	DBMS, communication management system (including LAN control), software development support tool (including CASE tools), operation management tool, TP monitor, ORB
	3. System configuration and method	3.1 System configuration technology	Client/server system (2-layer, 3-layer, multi-layer, RPC, and stored procedure), DB/DC system, distributed DB system, system configuration method (dual, duplex, hot standby, fault tolerant, hot site, cold site, cluster, TCMP/LCMP), processing modes (centralized and distributed, batch, real-time system, Web type computing, use of portable computer), transaction management (simultaneous execution control, exclusive control, failure recovery, rollback, and roll forward)
		3.2 System performance	Application of queuing theory, performance calculation (response time, throughput, TAT), performance design (system tuning, Amdahl solution, and response characteristics), performance index (SPEC-Int, SPEC-Fp, TPC, Gibson mix, response time), performance evaluation (benchmark, and system monitor)

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Knowledge field	Major classification	Intermediate classification	Major technical item
		3.3 System reliability and economical efficiency	Reliability calculation (calculation of operation rate, MTBF, MTTR, availability, failure rate, and FIT), reliability design (fail safe, fail soft, and fool-proof), reliability indicator and reliability evaluation (RAS, RASIS, bus tub curve, non-stop), economical efficiency (system profitability, and operation rate)
	4. System application	4.1 Network application	Web, Internet, intranet, extranet, mobile communication, satellite communication, CATV, communication services (ISDN, packet switching, frame relay, ATM, leased lines, circuit switching), application system (Internet shopping, groupware, and debit card)
		4.2 Database applications	Data warehouse (OLAP), data mart, OLTP, data mining, application system (accounting system, inventory management system, document management system and sales support system)
		4.3 Data resource management	IRDS (information resource dictionary system), meta data, and repository
		4.4 Multimedia system	AI, pattern recognition, AR/VR/CG, agent, media application (pattern recognition and synthesis of multimedia (sound, image and video), application system (Internet broadcast, nonlinear image edit system, video on-demand, and TV game)

Knowledge field	Major classification	Intermediate classification	Major technical item
III. System Development and Operation			
1. System Development			
	1.1	Language	Program structure ( <b>re-entrant</b> , reusable, overlay, and recursion), data type (integer type, <b>real type</b> , logical type, character type, abstract data type, and structure type), control structure (branch, selection, repetition, procedure, and function), language processors (compiler, linkage editor, loader, interpreter, assembler, cross compiler, DLL, and parallel processing), syntactic analysis (morphological analysis, <b>syntax-directed transfer method</b> , attribute context-free grammar, and context-free language), types and features of languages (FORTRAN, COBOL, PL/I, C, Pascal, C++, Lisp, Visual Basic, XML, SGML, PostScript, Java, Perl), types of languages (procedural, functional, logic and object-oriented)
	1.2	Software package	Development tools, operation management tool, business processing tools (finance and accounting, personnel affairs, management planning, sales management, inventory control, and business application classified by industry), ERP, CRM, SFA, SCM, CTI, Groupware (communication, data sharing, schedule management), PDM, CAD/CAM/CEA, OA tools, (word processing software, spread sheet, presentation software), Others (utility, multimedia, and entry in Japanese)
	1.3	Development environment	Development tools (design tool, programming tool, test support tool, CASE tool), EUC, EUD (use of spread sheet software, DB normalization, data manipulation and use of SQL)
	1.4	Development method	Software development model (waterfall, spiral, prototype), cost model, process maturity levels (CMM, SPICE, SPA), software life cycle, software reuse (reverse engineering, componentware)
	1.5	Requirements analysis and design method	DFD, ERD, UML, analysis/design diagramming (flowchart, NS chart, PAD), object-oriented design (inheritance, generalization, delegation, encapsulation, polymorphism ), <b>process-centered</b> design, <b>data-centered</b> design, <b>structured</b> analysis and design, module design (module cohesion, and module coupling), input/output design (report design, screen design, <b>item-code</b> design), human interface design
	1.6	Programming method	Programming method (procedural programming, logic programming, functional programming, object-oriented programming)
	1.7	Test review method	Test method (white box test, black box test), review method (inspection, walkthrough, design review), test design and management method (bug curve, error removal, coverage, test design, fault injection, system test and bug management diagram )

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Knowledge field	Major classification	Intermediate classification	Major technical item
		1.8 Development management	Project planning (initiation of project plan, profitability), quality plan, management and evaluation (QFD, software quality, and quality characteristics), process management (PERT diagram, Gantt chart, WBS, progress control and critical path), configuration management (specification management, and change control), estimation method (function point method, COCOMO, workload estimation, and cost estimation), personnel planning and management, document management (document protocol, and change procedures), productivity (size and workload), development organization and roles (development team staffing, and project manager), cost management and risk management
		1.9 Application system construction	Design and development of application systems (use of analysis and design methods, external design, internal design, programming, and test), use of software packages database design and operation (normalization, SQL, and use of network), and implementation of network
		1.10 System auditability	Audit method, audit trail, significance of system audit, and incorporation into system
		1.11 Use of external resources	Outsourcing, system integration, and co-sourcing
	2. System operation and maintenance		
		2.1 System operation	System operation management (computer system, database, network), system cost management (charges to users, TCO), system operation (job scheduling, data input/output management, and operation manuals), user management (ID issuance and management), distributed system management, hardware resource management, software resource management (library management, and version control), data resource management, network resource management, equipment and facility management (power supply, air conditioning equipment, equipment management, and facility management), system failure management (handling procedures, monitoring, recovery process, and preventive measures), security management, performance management, system operation tool (automatic operation tool, monitoring tool, and diagnostic tool), system transition (transition to operation phase, operation test, and version control), system operation service criteria
		2.2 System maintenance	Types of maintenance (daily inspection, periodical maintenance, preventive maintenance, post maintenance, and remote maintenance), software maintenance, hardware maintenance, and maintenance contract

Knowledge field	Major classification	Intermediate classification	Major technical item
IV. Network technology			
1. Protocol and transmission control			
	1.1	Network architecture	Network topology, standardization of communication protocol (OSI layer, X, V, I, and HDLC), application layer protocol (FTP, TELNET, SNMP, DHCP, POP, and SMTP), transport layer protocol (TCP, and UDP), network layer protocol: IP (IP address (subnet address, subnet mask), physical address (uni-cast, broadcast, and multi-cast)), data link layer protocol (ARP and PPP)
	1.2	Transmission control	Connectionless system, contention system, polling/selecting system, basic procedure, multi-link procedure, transmission control character, line control, and HDLC
2. Encoding and transmission			
	2.1	Modulation and encoding	AM, FM, PM, PCM, and sampling, analog transmission, digital transmission, coding, and compression
	2.2	Transmission technology	Error control (CRC, Humming code, parity check, bit error ratio), synchronous control (start-stop synchronization, SYN synchronization, flag synchronization, and frame synchronization), multiplexing methods (FDM, TDM), compression and decompression methods (JPEG, MPEG, MH, MR, MMR, run-length)
	2.3	Transmission and methods circuits	Communication methods (unidirectional/half duplex/full duplex, series/parallel, 2-wire/4-wire), WDM, switching system (circuit switching, store and forward, packet switching, ATM switching, frame relay, and cell relay), public network, and leased line
3. Network (LAN and WAN)			
	3.1	LAN and WAN	Transmission media (types and features of cables), LAN topology (bus type, star type, and ring type), Access control system (CSMA/CD, token ring), inter-LAN connection, LAN-WAN connection, peer-to-peer, point-to-point, high speed technology of LAN (FDDI, gigabit ether), wireless LAN
	3.2	Internet	Internet technology (inter-network connection equipment, TCP/IP, IP routing, DNS, PROXY server), e-mail (protocol, mailing list), Web (HTTP, browser, URL, HTML, and XML), file transfer (FTP), search engine (full text search type, directory type, robot type), QoS, CGI, and VOIP
	3.3	Network performance	Calculation related to line, transmission speed, line utilization rate, line capacity, traffic intensity, traffic design and performance evaluation, application of queuing theory
	3.4	Laws related to network	<b>The followings are Japan-localized national or domestic laws:</b> Telecommunications carrier regulations and laws, <b>Wire Telecommunications Law, Broadcast Law, Radio Law, Cable Television Broadcast Law</b> , technical standards

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Knowledge field	Major classification	Intermediate classification	Major technical item
		3.5 Network security	Encryption, authentication, firewall, and security protocol
		3.6 Telecommunications services	Leased line service, line switching service, packet switching service, ISDN, VPN, frame relay, cell relay, ATM, IP connection service, satellite communication service, mobile communications service, international communication service, VAN (value added communication network), QoS, DSL, best effort/guaranteed service
	4. Communications equipment		
		4.1 Transmission media and communication cable	Wire, wireless, radio wave, light, infrared rays, local line, toll line, pair cable, coaxial cable, optical fiber cable, IDF, and MDF
		4.2 Various types of communications equipment	Line terminal devices, multiplexing equipment, switching equipment, branch equipment, inter-network connection equipment (gateway, bridge, spanning tree, router, repeater, hub, and switch), line connection equipment (modem, DSU, NCU, TA, CCU, and PBX)
	5. Network software		
		5.1 Network management	Network management items (network operation management, configuration management, failure management, performance management, and accounting management), network management system, and network management tool (SNMP)
		5.2 Network OS	Network driver, and functions of network OS

Knowledge field	Major classification	Intermediate classification	Major technical item
V. Database technology			
1. Models of database			
	1.1	Database model	3-layer schema (conceptual schema, external schema, and internal schema), conceptual data model, logical data model (relation model, hierarchical model, and network model)
	1.2	Data analysis	Data modeling, ERD (entity, attribute, relationship), Normalization (1st normal form, 2nd normal form, and 3rd normal form)
	1.3	Data manipulation	Relational algebra (set operation (sum, difference, product, direct product), relational operation (selection, projection, combination, quotient))
2. Database language			
	2.1	Database language	Data definition language, data manipulation language, and end user language
	2.2	SQL	Data manipulation by SQL (table definition, data retrieval, data addition/deletion/update)
	2.3	API	Creation of program using embedded type SQL Creation of program using module language
3. Database control			
	3.1	Functions and features of DBMS	Major functions (database definition function, database manipulation function, database control function, transaction management, and user view function), features (assurance of data independence, database access, simultaneous execution process, exclusive control, failure recovery, and security), RDB, OODB, ORDB, and NDB
	3.2	Control function of DB	Exclusive control of DB, DB recovery (rollback, roll forward), DB transaction management function (ACID attribute)
	3.3	Distribution database	Configuration of distributed database, client cache, 2-phase commit, 3-phase commit, and replication

Knowledge field	Major classification	Intermediate classification	Major technical item
VI. Security		1. Approaches to secure computing	
		1.1 Confidentiality and tempering prevention measure	Cryptograph (public keys, private keys, DES, RSA, cryptograph algorithms), authentication (digital signature, message authentication, callback, user confirmation), access control (access right, password), digital watermarking, security management (entry and exit control, leakage prevention)
		1.2 Protection against illegal intrusion and computer viruses	Firewall, security protocol (SSL, PGP), hardware security, computer viruses, and computer vaccine
		1.3 Integrity	Data entry integrity, database integrity, software integrity, and log and audit trail management
		1.4 Availability	File backup, recovery, alternate or spare communication lines and communication control equipment, and reliability theory
		1.5 Privacy protection	Individual's information control, anonymity, pen names, and non-traceability
		1.6 Safety	Countermeasures against natural calamity (earthquake-proof), housing security, and UPS
		2. Risk management	
		2.1 Risk analysis	Risk identification, risk control, risk evaluation, risk analysis methods (quantitative risk analysis, qualitative risk analysis, and JRAM)
		2.2 Types of risks	Classification by peril concepts (fire, natural disaster, crime, illegal access, failures, etc.), classification by hazard concepts (physical hazard, moral hazard, etc.)
		2.3 Countermeasures against risks	Risk hedge (risk transfer, risk finance, computerization insurance), and contingency plan (classification of contingency, action plan against contingency, backup measure, and recovery plan)
		2.4 Internal control	Security regulation, security policy, and organization for security
		3. Guidelines and related laws and regulations	
		3.1 Guideline for security	Standards for information system safety measures, software management guideline, standard for preventing computer viruses, and standard for preventing illegal access to computers
		3.2 Guideline for privacy protection	OECD guideline, guideline for individual's information protection, and individual's information protection registration mark system

Knowledge field	Major classification	Intermediate classification	Major technical item
VII. Standardization			
1. Standardization for development and acquisition			
	1.1	Standardization for development and acquisition processes	ISO9000, ISO/IEC 12207 (SLCP-ICF98), ISO10006
	1.2	Standardization for evaluation of environment and security	ISO14000, ISO15408
2. Standardization for information system infrastructure			
	2.1	Standards	International standards (ISO, IEC), Japanese standard (JIS), American standards (ANSI), industrial standard (EIAJ-EDI standard, CI-NET, distribution EDI standard), and enterprise standards
	2.2	Open systems	X/Open, OSF, POSIX, COSE
	2.3	Standardization for data exchange	EDIFACT, STEP, Zen-gin (all Japan banking) procedures, CII, XML
	2.4	Component-based software standardization	CORBA, EJB
3. Standardization of data			
	3.1	Standardization of codes	Character codes (ASCII, ISCII, EBCDIC, JIS, shift-JIS, Unicode), bar codes (JAN code, ITF code, and ISBN code)
	3.2	Standardization of file formats	JPEG, GIF, BMP, TIFF, MPEG, SGML, XML, HTML, TEX, data formats (CSV format, SYLK format), PDF
	3.3	International System of Unit (SI)	Basic measurement units (meter, gram/kilogram/ton, second/minute/hour, ampere, kelvin, degree of Celsius, mole, candela), new SI measurement units (newton, pascal, joule, watt)
4. Standardization organizations			
	4.1	Standardization organizations	International organizations (ISO, IEC, IETF, IEEE, ITU), US public organizations (ANSI, FCC, NIST, MIL, and DOD), European public and industrial organizations (BSI, CENELEC, ECMA), Japanese public organization (JISC, JSA), industrial bodies (PCMCIA, ECMS, EIA, JEDEC, The Open Group), and Japanese industrial organizations (JEITA (Japan Electronics and Information Technology Industries Association))

Knowledge field	Major classification	Intermediate classification	Major technical item
VIII. Computerization and management			
1. Information strategy			
	1.1	Business management	Business strategy (portfolio, CSF, competitive analysis), organizations (CEO, CIO, CFO, COO, matrix organization, operating division organization, project team organization), marketing (marketing mix, price strategy, marketing research), behavioral science (motivation, group dynamics, leadership, KJ method, brain storming), system theories (general system theories, social systems)
	1.2	Computerization strategy	Information system (DSS, SIS, system evaluation, ERP, SCM, CRM, SFA, KMS, ASP, EAI), computerization conception (overall plan, medium- and long-term plan), systematization plan, business improvement, analysis, design (BPR, operation model, and business model), Businesses using internet (E-business/dot com business, virtual companies, and SOHO)
2. Accounting			
	2.1	Financial accounting	Accounting standard, financial statements (balance sheet, income statement), consolidated accounting (consolidated balance sheet, consolidated income statement, and consolidated cash flow account statement), and depreciation
	2.2	Management accounting	Break-even point, financial index (financial analysis, financial ratio analysis), cost (cost calculation, cost accounting system, lease and rental, fund plan, fund management (statement of cash receipts and disbursement, statement of source and application of funds), asset management (inventory control, valuation, and portfolio), tax accounting (corporate income tax, consumption tax, fixed assets tax), and economic efficiency calculation (DCF, IRR, remunerative comparison)
3. Management engineering			
	3.1	IE	IE analysis method (working hour analysis, work sampling, ABC analysis), OC curve, control charts (7 QC tools, Pareto's chart, and distribution chart)
	3.2	OR	Optimization problem (linear programming, inventory control), decision-making theory, game theory, probability and statistics, distribution function, Markov process, and simulation
4. Use of information system			
	4.1	Engineering system field	Production control system, production plan (productivity index), process plan and management (JIT, production line organization), MRP, CAD/CAM/CAE, FA, CIM, PDM
	4.2	Business system field	Accounting, finance and personnel affairs systems, sales support system, OA system, POS, distribution system, financial system, inter-enterprise system(VAN, EDI, CALS, EC), groupware, and work flow control tool

Knowledge field	Major classification	Intermediate classification	Major technical item
	5. Related laws and regulations		
		5.1 Laws and regulations concerning information communication	The followings are Japan-localized national or domestic laws: Telecommunications Industry Law, Wire Telecommunications Law, Broadcast Law, Radio Law, Cable Television Broadcast Law
		5.2 Laws and regulations concerning intellectual property right	Copyright Law, Patent Law, industrial property right laws (Utility Mode Act, Designs Act, and Trademark Law)
		5.3 Laws and regulations concerning labor	Laborer Dispatch Law, Labor Standard Law (3-6 agreement, night and holiday work), Law concerning the Promotion of Equal Opportunity and Treatment between Men and Women, Child Care Leave Law, Employment Security Law, Industrial Safety and Health Law, Employment Insurance Law, and Workmen's Accident Compensation Insurance Law
		5.4 Laws and regulations concerning transactions	Unfair Competition Prevention Law, Regulations Concerning Outsourcing (contract, contract for dispatch, consignment, commission, international transactions), Regulations concerning software sales (maintenance responsibility, license contract, shareware), securities and exchange Law, Civil Law, Visiting Sales Laws
		5.5 Law and regulations concerning safety	The Product Liability Law, Illegal Access Prevention Law, CE Marking, and Communication Interception Law
		5.6 Other related laws and regulations	Criminal laws (crime as false electromagnetic record or sharing of original copy, crime as illegal creation or sharing of electromagnetic record, crime as obstruction of business by breaking computers, etc. crime as fraud using computer, and crime as destruction of electromagnetic record), Commercial Laws (commercial transaction, stocks, directors, auditors, affiliate companies, and bills), Electronic Register Retention Law, Open Information Law (The Act for Protection of individual's information) Certification system (system integrator certification, SO certification, information processing engineer certification), and New Business Creation Promotion Law

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