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From the Editor

Today, there is a growing dependency on computers in the society and economy, and it is not too much to say that the stability and security of society depend on reliable and smooth operation of information systems. However, in the present state of affairs, there is a high risk of causing drastic social disorder due to trouble in the information systems, especially concerning software, which is still in a technically immature state, that relies heavily on the engineers who are in charge of it. We cannot get away from the fact that the demand for high-quality information systems is equivalent to the demand for high-quality information-technology (IT) engineers.

The chronic shortage of IT engineers has been being pointed out for many years up to now, during roughly 40 years of rapid computerlization. However, with the new wind in informatization as seen in networks and downsizing, we found a surplus in conventional engineers and a shortage in high-quality engineers in specialized fields. In other words, the recent issue is on the demands for quality rather than quantity. The immediate issue is training advanced IT engineers with a large stock of experience and advanced expertise and skills in specialized fields.

On the other hand, in order to enlarge the application fields of information systems and realize a rich information society, not only the technical personnel, but persons of every field, including executives and company employees, must become information literate and be capable of using and applying the information in their living and work areas. Schools and corporations must put effort into the enrichment of education according to their roles. It is also indispensable to have mutual cooperation of those organizations and an enrichment of instructors and equipments.

In order to deal with the present situation in which the range of informatization orientation is getting more diversified and advanced, it is first necessary to train the personnel for informatization as high-quality professionals. One means to improve the quality of IT personnel is to narrow the specialization according to various roles. In the pre-

sent situation with diversified technologies and user needs, it is impossible for one engineer to cover all of them. Therefore, the work of informatization should be classified, and each field should be made even more specialized to improve the overall quality. In 1993, Ministry of International Trade and Industry (MITI) announced and attempted in the classification of IT personnel from such a viewpoint. Based on this classification, JIPDEC has made every effort to train IT personnel through CAIT, an affiliate of JIPDEC.

Today, the Internet displays shocking world-wide progress. Applying such networks to education would provide inmeasurable convenience. Internet-based education support projects, such as the 100 School Networking Project, are under progress in our country as well.

With the present rapid progress in informatization with which every person has something to do, we are confronted with new issues, namely, the security of information systems, privacy, obscene images put on the network, cracking, etc. Such problems cannot be solved just by strengthening laws or regulations. It is necessary to establish sound information ethics for all persons involved with informatization. Especially now, where a visual information society is coming to reality due to the progress in virtual reality and multimedia, information ethics must be brought about as a part of education in order to realize an enriched information society.

In this issue, I have presented the actual state of education for informatization. I hope readers will find it useful to them.

Yuji Yamadori
Director
Research & International Affairs

I. Information-oriented Education in schools

1. Information-oriented Educational Policies of the Ministry of Education, Science and Culture

Looking at the progress of informatization in society and economy, it is needless to say that information-oriented education is absolutely necessary to the children that will shoulder the next generation. In order to correspond more appropriately to the rapid progress in informatization, the Ministry of Education, Science and Culture decided on an "Information Orientation Guidelines in Education, Arts and Sciences, Culture and Sports" in August 1995, and established basic policies and concrete measures for working on each field in education, arts and sciences, culture and sports. The information-oriented guidelines include the following matters established as the concrete measures, and information-oriented education of the Ministry of Education, Science and Culture will be enforced according to them.

- Improvement of physical conditions, such as systematically equipping schools with computers for education
- Promotion of the research and development of educational software, and providing such software to schools
- Enriched education and training of instructors, as school teachers
- Research, development and promotion of educational methods by means of multimedia, especially information network systems, such as satellite communication and optical fibers
- Establishment of various information-providing systems by using multimedia

(1) Government Guidelines for Teaching in Elementary and Secondary Education

The following items are incorporated into the present government guidelines for teaching in order to develop the abilities for using information in elementary and secondary education.

1) In junior high schools, along with the attempt to enrich computer use in mathematics and science, a

new field of "Information Basics" was set up in technical skills and home economics.

2) In high schools, along with the attempt to enrich computer use in mathematics and science, it was also made possible to set up courses and subjects, such as "Information", in general education. In the vocational courses, along with the enrichment of information processing education in commerce and industry, information-oriented subjects were incorporated into home economics, agriculture, fisheries, and nursing.

3) It was decided for teachers to use computers appropriately in each course lesson throughout elementary, junior high and high schools.

(2) Systematic Provision of Computers

An attempt is being made to provide computers for education in public schools, with the goal of 22 computers in elementary schools (one for every two pupils*), 42 in junior high schools (one for every student*), 42 in general education high schools (one for every student*), and 8 in special education schools (one for every pupil/student*) in approximately six years, starting from 1994.

* This is the number derived from assuming that 44 pupils are in an elementary school class, 42 students are in a junior high or high school class, and 8 pupils/students are in a special education school class, a computer education classroom is set up in a school, and computer classes are held there.

(3) Provision and Enrichment of Software

To provide the schools with excellent learning software, a "Learning Software Research and Development Project" is being worked on. An attempt is also being made to provide a nationwide "Educational Software Library Center" to provide the school personnel concerned with the opportunity to select the best educational software for learning activities.

(4) Enrichment in the Training of Teachers

To improve the teacher's teaching skills for developing the student's ability to utilize information, various courses and training are held, part-time instructors, such as IT engineers who are computer specialists, are commissioned for training and classes, and the teachers receive advice on

know-how and technical instructions.

(5) Utilization and Development of A New Information Means

Since 1992, several schools have been selected as equipment use research schools to advance the research in regard to teaching with the use of educational instruments, such as computers in schools. From 1996, 15 multimedia international exchange promotion research schools were designated anew, and practical research and study have been held concerning the enforcement of international exchange through the use of multimedia and networks. Furthermore, leading practical research is being held via the Internet as a network environment provision project (Called the 100-School Networking Project. Refer to III.1.) in cooperation with the Ministry of International Trade and Industry since 1994.

2. The Present State of Information-oriented Education in Schools

According to the report announced in October 1997 by the Ministry of Education, Science and Culture, the present state of information-oriented education in schools is as shown below.

(1) Elementary Schools

In elementary schools, since information education is not expressed clearly in the government guidelines for teaching, there is active incorporation of computers using the time from club activities and at school discretion on one hand, while 9.3% of schools have no computers on the other hand (From the research of the Ministry of Education, Science and Culture as of March 1997), creating a drastic gap between schools. Presently, an average of 8.5 computers is installed per school that possesses computers.

(2) Junior High Schools

In junior high schools, information education is held in the field of "Information Basics" in technical skills and home economics. This is a selective field, but 94% of the schools take this field according to a research done in 1996.

(3) High Schools

In many cases, "Information Processing" is set up in commercial courses, but there are also cases in which other subjects related to information in mathematics, science and general

education are provided.

(4) Special Education Schools

To children with disabilities, the use of information equipments and information communication networks means expanding the opportunity to participate in society, leading to great possibilities and importance. The expected level of equipment is reached at an average of 8 computers set up per special education school.

II. Training and Education for IT personnel in Various Organizations

1. Standard Curricula for Advanced IT Engineers Training and Education

On October 15, 1997, the Central Academy of Information Technology (CAIT), which is an attached organization to JIPDEC, announced the standard curricula for Advanced Information-Technology Engineer Training (called "standard curricula" from hereon, totaling 17 types) created in December 1993, after revising it to conform to later progresses in information technology, etc.

The standard curricula is in conformity with the types of IT engineers (decided on in 1992 by the Industrial Structure Council, an advisory body to the Minister of International Trade and Industry) demanded in a highly advanced infomatization society, and was created for effective and efficient training of personnel. Presently, education based on the curricula is being held in various training organizations, starting with vocational colleges, and "Information-Technology Engineers Examination" (a national examination based on Article 6 of "Laws Concerning Information Processing Promotion") is being held as a total personnel training system of an educational curriculum and evaluation system.

In addition, along with the revision of the standard curricula, the Information-Technology Engineer Examination (presently held in 13 areas) will be given in accordance with the revised standard curricula, beginning with the exam (fall exam) in October 1998 (expected date).

1. What is the Standard Curricula?

In December 1992, the Industrial Structure Council released an interim report, where they pointed out that the rapid progress of informatization, which can also be called a new information revolution, was indispensible for our country to strive for stable economic growth and realize a rich life of the people from

now on, and proposed the images of 10 new types of IT personnel to shoulder it, such as the "systems analyst", the issues to be solved in training such personnel effectively and the basic direction for corresponding to these issues. On the final report in May 1993, the same committee suggested a comprehensive support plan and standard curricula system directed toward the training of such new IT engineers, how the new exam system in connection with the standard curricula should be, and how the roles and cooperation of each educational organization should be.

In December 1993, under the direction of the Ministry of International Trade and Industry, CAIT set up an "Advanced Information Technology Engineers Training Curricula Committee (Chairperson: Eiji Kageyama, the then President of the JIPDEC)", examined the curricula in accordance with the suggestions, and put together the standard curricula consisting of 17 types.

The object of the standard curricula is in training advanced IT engineers who are demanded in an advanced informatization society. The standard curricula comprise (1) 13 types of "advanced IT engineers training curricula" to train personnel having advanced skills in specialized fields, (2) 2 types of "common curricula" which clarify the range of basic knowledge and practical business abilities that ought to be acquired in the period of one to five years after employment as a prior stage to (1), and (3) 2 types of "systems administrator training curricula" for the training and guidance of personnel to use the information system, for a total of 17 types (Figure 1). The point of each curriculum is basically placed on "how to help the students acquire practical business abilities, and how to instruct them to obtain such results".

From fiscal 1994, vocational colleges and IT engineer education organizations started to carry out education in accordance with the standard curricula, along with basing the questions covered in the Information-Technology Engineers Examination to the curricula, from October 1994, as a total personnel training plan for education and evaluation.

2. Revisions

When the standard curricula were created, personnel training was targeted to be foreseen five years ahead. However, the speed of progress in information technology thereafter exceeded expectations, and along with the client/server system becoming mainstream in the information system, network environments, such as multimedia, user interface, and internet/intranet, progressed rapidly, together with the spread of personal computers.

From the viewpoint of attempting integration with such progress in information technology, and from the fact that the questions in the Information-Technology Engineers Examination were based on the curricula, it was decided to reexamine part of the curricula without waiting the five years. In December 1996, the "Standard Curricula Adjustment Committee (Chairperson: Fumihiko Kamijo, Professor at Tokai University)" was set up, and revision work was held to adjust the contents of the standard curricula to the progress in information technology.

The new revisions were done under the following basic ideas for the necessary revisions to go hand in hand with the rapid progress in information technology.

(1) Set the types of advanced IT engineers and standard curricula system as they are.
(2) Add and update the technologies and surroundings to be indicated in the standard curricula to go along with the latest circumstances.
(3) Also modify the following matters, based on the experience of using the curricula.
   - Educational goals, learning objectives
   - Order of chapters and sections
   - Learning time for lectures and practice
   - Points to pay attention to for instruction
   - Books for reference, etc.

Four curricula, such as the education engineer training curriculum, are not revised.

3. Major Points of Revision

The major points of revision in the standard curricula are shown below.

(1) Reexamination of related technologies that accompany the

spread of personal computers, internet, groupware, etc.

(2) Reexamination of structure and expression, elimination of overlapping contents, unification of terms, adjustments related to other curriculas, and reexamination of learning objectives and learning time

(3) Reexamination of the development processes and product names

(4) Reexamination in accordance with the revision of various standards and specifications, such as the systems auditing standards

For any question, please contact the Promotion Department at the Central Academy of Information Technology (Phone: +81-3-5531-0177, homepage URL: http://www.interport.ne.jp/cait/).

Figure 1 System Chart of Standard Curricula

Class II Common Curriculum

Electives	Application Ability	(1) Basic Skill for Internal Design (2) Program Design Skill (3) Basic Skill of Design for Microcomputer Application Systems
Common	Application Ability	(1) Programming Skill (2) Presentation Skill
	Knowledge	(1) Computers and their Use (2) Mechanism of Computer (3) Basics of Software (4) Algorithms and Data Structures (5) Basics of Systems Development (6) Files and Database (7) Communications Network (8) Information Processing Systems (9) Industrial Society and Informatization (10) Social Issues of Informatization

Class I Common Curriculum

Electives	Application Ability	(1) Application Systems Development Skill (2) Basic Systems Development Skill (3) Systems Evaluation Skill (4) Microcomputer Application Systems Development Skill
	Knowledge	(1) Systems Configuration Technique (2) Operation of Systems (3) Information Security and Systems Auditing (4) Management Science and Enterprise Systems (5) Microcomputer Application Systems
Common	Application Ability	(1) Communications Skill (2) Problem-Finding and Solving Skill
	Knowledge	(1) Basics of Computer Science (2) Computer Architecture (3) Communications Network (4) Basic Software (5) Database (6) Software Engineering (7) Human Interface

Training Curricula for Advanced IT Engineer

I. Personnel planning out, designing, developing, operating or evaluating information systems

(1) Training Curriculum for Systems Analyst		
(2) Training Curriculum for Systems Auditor		
(3) Training Curriculum for Project Manager		
(4) Training Curriculum for Application systems design Engineer		
(5) Training Curriculum for software design & Production Engineer		
(6)	Technical Specialist	1) Training Curriculum for Network Specialist
		2) Training Curriculum for Database Specialist
		3) Training Curriculum for Software Production Technology Specialist
		4) Training Curriculum for Basic Systems Specialist
(7) Training Curriculum for Systems Operation Management Engineer		

II. Educator of engineers and others

(8) Training Curriculum for Education Engineer

III. Personnel developing Systems Software or Microcomputer Application Systems

(9) Training Curriculum for Development Engineer
(10) Training Curriculum for Microcomputer Application Systems design Engineer

IV. Personnel to Lead Informatization on the Side of the User

Training Curriculum for Systems Administrator	(11) Training Curriculum for Senior Systems Administrator

2. Summary of Each Curriculum

2.1 Class II Common

This curriculum is comprised of subjects for acquiring knowledge and application abilities. The subjects on knowledge are taught to help the students understand the contents thoroughly, and the subjects on application abilities are taught to help the students use such knowledge fully in routine work. The subjects on knowledge are all common parts and those of application abilities are comprised of common parts and elective parts.

Part 1 Computers and their Uses

First time learners of computers must understand the concepts of what a computer is, the mechanism and functions of a computer, and the basic operating procedures and uses, from both aspects of hardware and software.

Part 2 Computer Mechanism

The object of this part is for the students to acquire the necessary basic knowledge concerning the hardware for playing an active role as IT engineer.

Part 3 Software Basics

The students must first understand the basic ideas of software, on what software is and the roles of hardware and software, and then recognize their importance. Operating systems and language processors are taken up, especially as essential software, along with the software classification and system.

Part 4 Algorithms and Data Structure

The base of program design is algorithm design. Similar to the design of information processing systems, consisting of many design levels extending from external design to internal design, algorithm design also consists of many levels in regard to the degree of detail. Insight into algorithm is important even at the point of external design. For this reason, the algorithmic perception of problems is fostered.

Part 5 Systems Development Basics

The skills that must be attained in the Class II Common Curriculum are programming, unit testing and maintenance, and internal design, program

design, and cumulative testing under the direction of an senior engineer. The object of this part is for the students to understand the summary of the entire process in accordance with the waterfall model.

Part 6 Files and Database

The students must understand the concepts of files and database, and master the knowledge in regard to these items.

Part 7 Communications Network

The students must acquire basic knowledge, such as the roles and basic information of telecommunications network, network architecture, telecommunications services, and local area network (LAN).

Part 8 Information Processing Systems

The students must understand how the hardware, system software, and application software share functions while uniting organically to work effectively as an information processing system.

Part 9 Industrialized Societies and Informatization

The students must acquire basic understanding in regard to the mechanism of industrialized societies and organizational bodies (corporation) in order to foster the abilities to understand and analyze his work and its surroundings as a "system". The basic skills for reconstructing these as a "system" must also be acquired. Furthermore, it is necessary to have the knowledge concerning how this kind of system is being realized in actuality.

Part 10 Issues in Informatization

The students must understand the issues in informatization with a broad outlook on the international situation and social environment, and be able to make use of that knowledge, as a promoter for a sound information society, in work and routine activities.

Part 11 Programming Skill

This part helps in fostering the students' skill to create an appropriately-sized program on their own, as a module or compiled unit.

Part 12 Presentation Skill

The greatest educational goal is for the students to master the basics of expressive skills. Specifically, the students will learn the methods of speaking, writing, and visual expres-

sion, and be able to apply them properly.

Part 13 Basic Skill in Internal Design

The object is for the students to understand the work of internal design so that basic internal design work can be done under the direction of the instructor.

Part 14 Program Designing Skill

The students must thoroughly recognize the meaning and importance of module division, along with mastering the technique for optimum module division through practice. Class II level information processing engineers are expected to be able to design programs as practical business under the direction of an instructor. Therefore, the acquisition of program designing skill is a requirement.

Part 15 Basic Knowledge in Microcomputer Application Systems Design

First time learners of microcomputer application technology are made to understand the ideas of microcomputer application technology and use elementary design technology.

2.2 Class I Common

The Class I Common Curriculum is similar to the Class II Common Curriculum. As Class I level learners are thought to have a clear orientation of the future by now, the courses on both knowledge and application abilities are comprised of common and elective subjects. Mastery of the Class II Common Curriculum is a prerequisite to learners of this curriculum.

Part 1 Computer Science Basics

The students must understand the basic logic and principles of creating software from a scientific standpoint.

Part 2 Computer Architecture

The students must acquire the basic knowledge on hardware technology and architecture basics of data constituents in regard to the diversification of computers, and then apply them properly in practical business.

Part 3 Communications Network

Students are educated on the basics of telecommunications network use in information systems.

Part 4 Basic Software

The students must equally master the operating systems of mainframes, WSs, and PCs, to optimize the ability and performance of available computers.

Part 5 Database

The knowledge on database required for class 1 level information processing engineers is as follows.

(1) Basic concept of database
(2) Creation and operation of database
(3) Using database

Part 6 Software Engineering

The results of the software engineering are taken up on the assumption that it is introduced into the systems development process as a technology. Along with fostering the viewpoint to see the software as an object of engineering, the students must master each system development technology based on software engineering.

Part 7 Human Interface

The object of this part is for the students to organically master the two aspects of conceptual knowledge and individual technical knowledge on human interfaces. The students must understand the social significance of computer systems in connection with the future progress in human interfaces.

Part 8 Systems Configuration Technique

The advanced IT engineer's job is to decide the system configuration that corresponds to the demanded matters and perform the SI work. During the process to reach this level, it is important to acquire and gain experience on the basic knowledge of system configuration technique. The basic knowledge is provided to the students from such a viewpoint.

Part 9 Systems Operation

The students must understand the way of systems operation and the future trend in information processing. It is thoroughly explained that not only system design and development, but operation and maintenance are also essential factors to a system. The object is for the students to understand the factors constituting the system, and build an operating mechanism and acquire the knowledge for providing stable operation support under the direction of a Systems Operation Management Engineer.

Part 10 Information Security and Systems Auditing

The students are educated on the items related to information security and systems auditing that all personnel involved in information processing should be aware of in order to promote sound informatization in organizational bodies.

Part 11 Management Science and Enterprise Systems

The object is to foster the students' outlook and abilities to get an unobstructed view of the entire enterprise system by linking various areas corresponding to the practical aspect of the enterprise system, and not by gathering together fragmentary knowledge.

Part 12 Microcomputer Application Systems

The object is for the students to acquire the knowledge of the architecture of microprocessors, memory, and buses that configure the microcomputer and constituting factors of peripherals, knowledge regarding real-time, and knowledge regarding the development technology of microcomputer application systems.

Part 13 Communications Skill

The students must systematically master the basic skills that are indispensable to IT engineers in communication activities, and be able to communicate effectively by making use of them.

Part 14 Abilities to Find and Solve Problems

Personnel involved in the development, maintenance, and operation of the information systems are in a position to deal with problems as responsible persons within their organizations. Therefore, the skills in finding and solving problems are chiefly positioned as indispensable technical abilities. With consideration to such positioning, the skills mentioned here for finding and solving the problems are composed in accordance with practical business, based on a methodology that places importance on the practical business affairs.

Part 15 Application Systems Development Skill

The students must acquire the ability to put all work into practice in conformity with systems development procedures, under the direction of an advanced IT engineer or on their own.

Part 16 Basic System Development Skill

The students must acquire application abilities for planning and developing systems software as a class I level engineer, under the direction of an advanced IT engineer (Development Engineer).

Part 17 Systems Evaluation Abilities

Systems evaluation is integrated evaluation with many sides to it. The students must understand the purpose of evaluation under the direction and support of an advanced IT engineer, and acquire the knowledge and ability for carrying out evaluation work in an environment equipped with manuals and tools.

Part 18 Microcomputer Application Systems Development Skill

The object of this part is to help class I level IT engineers, who create input/output programs and internal information processing programs in the microcomputer application systems of realtime processing, acquire the application skill and be able to design software.

2.3 Systems Analyst (SAN)

To develop the abilities to analyze and propose total strategic information systems for the rationalization and progress of corporation activities, the students will acquire the practical business abilities in regard to the approaches and skills for proposing the overall plans and development plans of information systems. Learners in this curriculum must possess the general knowledge and experience in regard to administration management (organization, personnel, finance, business) and the flow of systematization (planning to operation).

(1) Role of SAN

In executing the corporate strategies, the systems analyst solves the administrative issues and proposes the general plans for the information system, including how a business or organization should be, in order to support the intentions made in regard to those issues. As a CIO staff, the systems analyst receives cooperation from the Application Engineer and technical specialist to play the following roles.

i) Propose information strategies based on the corporate strategies, and obtain approval from the management.

ii) Propose middle and long term general plans for the information system based on the information strategies, and obtain approval from the management.

iii) Propose a development plan of individual information systems defined by the general plans of the information system, and pass the work over to a development personnel, such as the project manager, after obtaining approval from the persons concerned.

(2) Principal Duties of SAN

The principal duties of the systems analyst is shown below.

i) Understanding corporate strategies and administrative issues

ii) Proposing information strategies

iii) Proposing general plans of information systems

iv) Proposing development plans

v) Evaluating and reexamining after carrying out the plans

Part 1 Management and the Information Systems

The information strategies must be consistent with the corporate strategies. Therefore, the instructor will explain the basic matters of management in general, such as the corporate strategies, administrative issues, administrative management, and administration organizations, and show how to propose information system framework. Evaluation of the information systems and measures against risks and security will also be explained, since the entire enterprise operation can be drastically affected when there are problems in the reliability and safety of the information systems.

Part 2 The Trends of Information Technology and Changes in the Environment of Information Use

It is necessary to recognize information technology trends properly and make use of them in the corporate strategies and information strategies of the corporation. As an advanced IT engineer, it is the systems analyst's duty to assist the CIO regarding information technology trends. The instructor will help the students acquire such abilities and knowledge required.

Part 3 Proposal of A General Plan of the Information System

The teacher will instruct the students on how the systems analyst supports the responsible executives in propos-

ing a general plan of the information system, and how to propose it effectively.

Part 4 Proposal of Development Plans
Development plans of a priority theme are proposed, based on the general plans of the information system, in order to clarify concrete actions. This process links information strategies with application development (design, and production).

2.4 Systems Auditor (SAU)

To develop the abilities to inspect and evaluate fair construction and operation of information systems from an objective standpoint, the students will master the audit procedures and techniques required for proposing and enforcing audit plans, the basic knowledge on information systems evaluation and security, and abilities of audit practice, through case studies based on typical audit cases such as giving advice and suggestions to persons concerned regarding the check results.

(1) Role of SAU
From an independent and objective standpoint of the object being audited, the Systems Auditor (SAU) inspects and evaluates information systems comprehensively, and then gives advice and recommendations to the persons concerned. The applicable range covers all items concerning the reliability, safety, and efficiency of the information systems.

(2) Principal Duties of SAU
The principal duties of the SAU are shown below.
i) Establish system audit plans for the entire information system and

particular parts.

ii) Enforce system auditing using a procedure, such as preliminary investigation, actual investigation, and creation of an audit report, based on the systems audit plans.

iii) After enforcing systems auditing, create a report from the gathered results on the problem points of the information system, including the items pointed out and recommendations on improvement.

iv) After submitting the report, follow up on the state of improvement in regard to the recommendations.

Part 1 Basic Knowledge of the Information Systems

The educational objectives are to understand the basic knowledge systematically in regard to the information systems applicable to the systems auditing, administrative activities and organizational behaviors supported by the information systems, and information systems management, and to solidify the base for developing each specialized technique and skill effectively.

Part 2 Systems Auditing Basics

The objective is to help the students acquire the basic knowledge systematically for enforcing the systems auditing effectively as a SAU.

Part 3 Enforcing the Systems Auditing

Acquisition of knowledge on systems auditing alone is not enough for enforcing the systems auditing. The educational objectives are to divide the work of systems auditing into planning, enforcement, and reporting, and then help the students understand the specific tasks for each stage, deepen their understanding in the knowledge of systems auditing acquired in part 2, along with the flow of duties in systems auditing, and enable them to execute auditing as a SAU.

Part 4 Related Laws and Regulations

It is necessary to know the basic contents of the laws in connection with the execution of auditing. The objective is to help the students acquire basic knowledge on them.

Part 5 Case Studies of Systems Auditing

By taking up typical aspects and objects generally recognized as the cases in auditing, the instructor will foster the basic abilities of the students to create audit reports by showing the way to break each case down, analyze the facts of the problem, and center in on and arrange the items pointed out and recommendations for improvement.

2.5 Project Manager (PM)

To develop the abilities to carry out the planned systems development with the planned budget, construction period, and quality, the students will acquire the expertise, skills, and practical business abilities required in project management, such as proposing a development project (schedule, quality, expenses, orders to outside suppliers, etc.) and finding the problems and solutions in operating the project, as well as the abilities to evaluate and analyze the total plans and results that lead to development of the next system.

(1) Role of PM

It is becoming difficult to manage the systems development project with methods based on the conventional management techniques made full use of by general office managers or the past experiences of senior engineers. With the diversification of technological progress and needs, the period for one engineer to be familiar with everything has come to an end, and the project manager (PM) has become an independent engineer along with the progress in technology specialization. The PM makes full use of the knowledge and skill regarding com-

prehensive and specialized project management, and plays the following roles in regard to the project.

i) Use the provided resources fully, starting with personnel, to finish system development with the planned expenses, period, and quality.

ii) When external organizations (clients, joint ventures, and subcontractors (outside suppliers)) are involved, enter into a suitable contract and keep a good relationship.

iii) Cooperate with software production technology specialists to realize overall quality assurance.

(2) Principal Duties of PM

The duties of the PM mainly comprise projection, project management, and project completion evaluation.

Part 1 Projection

The instructor helps the students acquire the knowledge in regard to projection, and learn how to establish project policies and objectives and set up project organization.

Part 2 Project Management

The teacher will help the students acquire the practical business abilities in project management regarding the various management types, such as progress management, quality management, staff management, subcontractor management, expense management, confidentiality and agreement management, and specification modification management.

Part 3 Project Completion Evaluation

The focus of project evaluation is on differential analysis between the planned and actual results. The method of classifying and tallying up the resulting data will differ according to the viewpoint and item compared in regard to progress, productivity, cost, and quality. The instructor will help the students understand through practice how to execute differential analysis between the planned objectives and actual results of progress, productivity, quality, and cost, and evaluate the actual results of the developed project regarding productivity, quality, and cost.

Part 4 CSS (Client Server System) Development Management

The instructor will educate the students to understand and recognize the CSS development characteristics and the foreseen risks in CSS development,

avoid such risks, and take the appropriate action in management required for effective CSS development. On the premise that universal project management applying generally to systems development is handled in another part, the instructor will educate the students on the points in the development phases that should especially be paid attention to in the CSS.

Part 5 Related Laws and Regulations

The instructor will help the students understand how to interpret the related parts of laws and regulations concerning order placement and receipt, intellectual rights, various guidelines, product liability, etc.

2.6 Application Systems Design Engineer (AE)

The students will acquire the practical business abilities to carry out design review, system testing, analysis and modeling of the work concerned, setting of the requirements, and external design in order to propose and construct an optimum system for individual applications. Modeling abilities will be acquired through practice, mainly from quasi-experiences.

(1) Role of AE

The AE is an engineer that possesses the technical knowledge and practical business abilities for analyzing and modeling applications, and designing and constructing information systems. For the construction of an information system, the AE cooperates with other advanced IT engineers to play the following roles.

i) Cooperate with the Systems Analyst (SAN) when proposing the plans of a strategic information system or an overall business integration system based on the corporate strategies, and share the plans of individual systems.

ii) Plan an optimum system for individual applications, and enforce

analysis for user needs, demand specification settings, and external design.

iii) Propose the plans for design review, system testing, transition and operation, and execute a part of them, if necessary, with the cooperation from other advanced IT engineers.

(2) Principal Duties of AE

The principal duties of the AE are shown below.

i) Systems orientation plans
ii) Systems analysis and requirements
iii) External design
iv) Requirements for databases and networks
v) Design review
vi) System test plans
vii) Transition and operation plans

Part 1 Projection of An Informatization Design

The instructor will educate the students to understand how the projection of information strategies, overall system orientation plans, and development plans are carried out by the Systems Analyst (SAN) before the work of the AE, along with how it should reflect smoothly on the AE's duties of systems analysis and requirements.

Part 2 Systems Analysis and Requirements

"Modeling" is the most demanded ability of the AE. Therefore, the instructor must prioritize and put aside enough time for training the students' modeling abilities in practice, rather than in lectures, so the students can use them in actual practice.

From the viewpoint mentioned above, the instructor will help the students acquire the systems analysis technique, systems requirements description and systems design technique.

Part 3 External Design

In order to make the system design determined in "Systems Analysis and Requirements" more concrete, the instructor will help the students determine the "external specifications", or system seen from users, and instruct on the skill for defining the requirements to other advanced IT engineers, with the focus on practice.

Part 4 Design Review and System Test Plans

In order to provide a system that suits

user needs and satisfies users, it is important to understand what quality assurance is and what should be done to secure quality. Therefore, the educational objective is to help the students learn the following matters in this part, and be able to apply them.

1) Quality assurance mechanism (includes ISO9000)
2) Design review
3) System test plans

Part 5 Transition and Operation Plans

In order to run the new system without trouble, it is necessary to ready the environment, and shift over the hardware, software, and files (various data) smoothly. The aim is in teaching the students what the necessary basic items are for projecting shiftover and operation plans.

2.7 Software Design & Production Engineer (PE)

Based on the external design created by the Application Engineer, in order to foster the abilities to develop individual applications and application packages, the students will acquire the practical business abilities in each process, from internal design to program production, testing, and maintenance, along with the related knowledge and technologies, such as the quality, maintainability, and efficiency demanded in software development.

(1) Role of PE

The PE is an engineer in charge of materializing the system planned and designed by the AE in the development of individual task applications and application packages into a more concrete information system. Applications comprise business applications and engineering applications, and the PE deals with both.

It is also a very important task to instruct class I level IT engineers.

(2) Principal Duties of PE

The PE's work is focused on the processes, such as internal design, pro-

gram production, testing, transition and maintenance, establishment of development standards (with the direction and assistance from the SSP), and evaluation, selection, and building of the development environment, and also includes package customization.

Part 1 Internal Design

The role of the PE in the internal design process is not just to make the external design results more detailed, but to materialize a system model up to a level enabling program production, while securing software quality. It is indispensable to master the knowledge and techniques based on the science, logic, and rule of thumb, and have the abilities to develop and maintain high quality software with high productivity while using the appropriate tools. The aim is in helping the students acquire the technology required for the PE to carry out internal design properly.

Part 2 Program Production

The objective is to acquire the following skills required for the PE to properly play the role as an actual personnel of program production.

1) Descriptive skill and review skill of module design packages.
2) The skill for setting appropriate program production standards, examining common specifications, and selecting standardization techniques.
3) Skill of creating document standards for accurate (even stricter) descriptions, and of description by easy-to-understand processing structural expressions.
4) The skills for evaluating and selecting program languages, CASE tools, structuralization techniques, data-centered approaches, and object orientation techniques that are appropriate for program production.
5) Program structure expression skill for judging whether the codes reflect accurately on the module design, and program production skill that can be debugged easily.

Part 3 Testing

Testing is still one of the PE's main duty. Just as the testing of hardware products is essential, the finished product quality, project construction period, and profitability will drastically change by how the testing is planned and carried out for software. The objective is to help the students acquire the knowledge and skill re-

quired in the strategic and effective enforcement of testing.

Part 4 Transition and Maintenance

The objective is to help the students acquire the following skills required in executing shiftover and maintenance accurately as a PE.

1) The skill to clarify the shiftover method and procedure, and then shift over smoothly, effectively, and accurately.
2) The skill for researching on the present problems in maintenance and new maintenance technology applications, and setting maintenance policies and plans, after understanding the type and content of maintenance.
3) Understanding of maintenance responsibility of maintenance managers and the state of maintenance, and management skill of maintenance history.
4) The skill of reducing the maintenance load and rebuilding the current software. Also the skill for using various tools that increase maintainability and enable a more systematic maintenance.

Part 5 Quality Control

The objectives are to help the students acquire the following knowledge and skills required in creating even better software as a PE.

1) Specialized knowledge and skill for ensuring software quality.
2) The skill for understanding the software quality characteristics, clarifying what kind of software is good, and evaluating it.
3) The skill for understanding how to review the making of high quality software, and enforcing an effective review.
4) The skill for understanding various techniques that can be used in general quality management activities, other than review, and using them in actual software development.

Part 6 Development Environment

The objectives are to help the students acquire the following knowledge and skills required in accurately building the optimum development environment as a PE to apply to each development process.

1) Recognition of necessity and importance of an integrated software development environment, and the basic knowledge and applica-

tion of the elements that constitute it, namely, development methodology, development assistance tools, platforms, and repositories.

2) Understanding the characteristics and effectiveness of development tools used in each process of software development, and the skill to apply them in practical business.
3) Understanding the importance of a development environment with the assumption of recycling software, and the skill to create, use, and manage the parts that construct it.
4) Understanding the characteristics and effectiveness of the development methodology, which is the base knowledge in software development, and its tool of assistance, CASE, and the skill to set, use and apply a development environment based on practical business affairs.

Part 7 Latest Technology Trends in Software Engineering

Needless to say, software engineers of the new era must have the present knowledge and techniques and be able to use superior tools, but must also have concern in the software engineering technology trends at all times, and at times, attempt in using the newest technologies.

The objectives are to help the students acquire the following technical trends required.

1) The progress from structuralization techniques to object orientation techniques, and the trends concerning analysis and design techniques of formal specification description methods.
2) Trends concerning the development environment and development assistance tools.
3) Trends concerning artificial intelligence, e.g. expert systems.
4) Trends concerning Internet and intranet application system development technologies.

Part 8 Data Structure and Algorithm

The objectives are to help the students select the appropriate data structure and algorithm for the exercises provided, and acquire the skill and knowledge for programming them properly.

2.8 Network Specialist (NSP)

To develop the abilities to execute network systems planning, design, construction, operation, maintenance, and give technical support, the students will acquire the expertise related to network technology, communications, and laws, along with the series of practical business abilities, from network design to operation and maintenance, by using typical model systems.

(1) Role of NSP

The NSP is a specialist in charge of planning, designing, constructing, evaluating, operating, and maintaining the data transmission network system as a common base for realizing various application systems. The NSP is mainly in charge of dealing with OSI models, and plays the following roles.

i) Plan, design, construct, and evaluate the basic network system.

ii) Based on the demanded network system specifications submitted by the Application Engineer, clarify the functions, performance, and profitability of it, and then establish the design requirements.

iii) Based on the design requirements, execute network design in the two stages, logical design and physical design.

iv) Based on the network design, establish the construction plans, and direct and enforce construction.

v) Establish the test plans of the network system, and direct and enforce testing. Also, work on improving the network system based on the test evaluation results.

vi) Direct operation and maintenance, along with establishing the network system operation management requirements and network operation system.

(2) Principal Duties of NSP

The NSP directs and enforces the series of work regarding the network system, such as planning, setting requirements, design, construction, evaluation, operation, and maintenance.

Part 1 Requirements, Design, Construction, Testing, and Evaluation of the Network System

The teacher will help the students acquire the techniques regarding network systems design, construction, testing, and evaluation, that the NSP independently shoulders as a special-

ist. Networks extend over a broad area, from small scale local area networks (LANs) to large scale global networks which cover the entire world, from exclusive information processing to multimedia. Training the NSP to handle the networks of all ranges is extremely difficult. Therefore, this part will combine an education curriculum of design, construction, testing, and evaluation that is common to the various networks, with a practical business curriculum applicable to typical models.

Part 2 Operation and Maintenance of the Network System

The instructor will help the students acquire the necessary knowledge, skills, and techniques, for network systems operation and maintenance, as an NSP. The emphasized points are mainly listed below.

1) Systematic understanding of the necessary elements and requirements for network systems operation and maintenance management.
2) Doing a study on how to enforce information systems operation and maintenance management.
3) Systematic understanding of the network management system and basic knowledge for introduction.

Part 3 Network Engineering Technology

The basic logic and technologies of network engineering were compiled to help the students acquire the common knowledge for strengthening the basic abilities as an NSP. Starting with the network architecture technology, the contents include traffic, reliability, coding technology, and data transmission technology.

Part 4 Network System Constituents

The instructor will help the students learn the types, characteristics, and uses of telecommunications services, provided by Type I telecommunications carriers*, VAN, and LAN, and then study on transmission and exchange devices and network software that constitute such networks.

* Type I telecommunication carriers are facility-based common carriers.

Part 5 Network-related Laws and Standards

The instructor will help the students master the contents and application of domestic and international legislation, related international and domestic standards, technology standards, and de facto standards that keep the telecommunications business in order.

2.9 Database Specialist (DSP)

To develop the abilities to execute management, basic database construction and operation, and provide technical support in utilizing the information resources possessed by corporations, the students will acquire the expertise on the procedure and element technology, and the newest technological trends for realizing data models and databases, along with the practical business abilities concerning database system design and management.

(1) Role of DSP

The technical specialist in charge of databases (DSP) plays the following roles.

i) Manage data resources of entire corporations and organizations.
ii) Construct and upkeep the basic databases.
iii) Support database-related technology.

(2) Principal Duties of DSP

The duties of the DSP are shown below.

i) Work analysis and data modeling
ii) Database design
iii) Resource management and standardization

iv) Technical consultation

Part 1 Basic Database Logic

The instructor will help the students master the knowledge required in establishing an information base, and the following knowledge required to be applied in the stages, such as planning, analysis, and design, as necessary advanced knowledge for technical support.

1) The importance of information resource management and repository roles and functions, significance and characteristics of a data-centered approach, and the basic logic and knowledge in regard to data modeling
2) The ideas concerning data models, and the basic logic and knowledge in regard to logical and physical data models
3) The characteristics and functions of related models, and the basic logic and knowledge in regard to normalization

Part 2 Database Management System (DBMS)

The instructor will help the students acquire the following knowledge to enforce technical support in regard to databases at each stage of the information system life cycle.

1) Understanding the DBMS architecture
2) Understanding the definition, operation, and inquiries in regard to DBMS
3) Ideas of distributed databases
4) DBMS selection evaluation

Although not the person to develop the database management system, it is necessary to train the DSP to understand the database management system structure and functions, know the techniques and pluses and minuses of realizing such functions, and consult and give technical support to other personnel in regard to the databases.

Part 3 Database Systems Design and Operation

The instructor will help the students understand the importance of information systems development using a data-centered approach, and execute the following items in order to acquire database systems design abilities that go along with it. The objective is to improve the abilities of the students to apply the already acquired basic logic into practical business.

1) Projection of a database system plan in the information system

development process using a data-centered approach

2) Analysis methods and Data analysis, such as data standardization, ER analysis, and data normalization
3) Data definition, code design, and design of a database logic data model and logic process, based on the data analysis results
4) The technical support concerning the actual designing of physical data models and database systems, based on the database management system's abilities and characteristics to be applied

Part 4 Database Technological Trends

The instructor will help the students acquire the following technological trends in regard to databases for the planning and projection of database system development and operation management, so that proper policy determination consultations can be held.

1) Trends on database standardization
2) Trends and evaluation of the newest database technologies
3) The newest trends of the system technology, deeply connected with the databases

2.10 Software Production Technology Specialist (SSP)

To develop the abilities to support efficient and high quality software development from the sidelines, the students will acquire the expertise on software production technology and development strategies, and development techniques, along with the practical business abilities for enforcing development work standards, quality assurance, and evaluation of productivity.

(1) Role of SSP

The SSP plays the role of supporting the software development work from the sidelines, so other IT engineers can proceed efficiently with software development. As a direct task, the SSP provides the software development environment to become the base of software development work, but most of the SSP's work is to play an indirect role in the software development work itself, to carry out support activities for other IT engineers. For this reason, the SSP is required to have a broad range of knowledge and high technical level to support other IT engineers in every stage of the software development process.

Specifically, the SSP plays the following roles.

1) Management of software development environment construction and development resources.
2) Settling on software development environment evaluation and strengthening strategies.
3) Direction in regard to software development environment use.
4) Establishment of software development standards.
5) Technical consultation concerning software production technologies for one's organization or other organizations.

(2) Principal Duties of SSP

The SSP directs and enforces the series of work regarding the provision of a software development environment and establishment of development standards.

Part 1 Software Production Technology Trends

The SSP gives other IT engineers technical consultations in regard to improving quality and productivity in software development. For this reason, the SSP must always have the newest information on software production technology on hand in order. The learning objective is to help the students master the general software production technologies, and incorporate new production technologies along with existing ones.

Part 2 Software Development Strategies

More than supporting the information systems development project and supporting operation and maintenance management, the SSP must hold reexaminations and evaluations periodically on the overall software production technology that is adopted in unification in organizations, and work out development environment strengthening strategies according to the degree of maturity. The instructor will help the students acquire the technique for a more applicable evaluation and enrichment of software development technology, along with the abilities enabling application, so that the SSP is relied on as a specialist in other projects and the activities are effective.

Part 3 Software Development Techniques

An important item for which the SSP gives consultations in the actual software development project is the soft-

ware development techniques. The educational objective is to help the students acquire the knowledge and practical business abilities for contributing to improving quality and productivity in the present software development project.

Part 4 Software Development Environment

A principle task of the SSP is constructing the software development environment. The instructor will help the students understand the knowledge of development environment constituents and the principle procedures in development environment design required for development environment construction, and acquire the abilities for designing the optimum development environment. For this reason, the emphasis is placed on understanding the procedure for ascertaining the function to be realized as the development environment, rather than the knowledge on individual tools.

Part 5 Software Development Standards

The instructor will help the students understand the importance of standardization, not only to know the processes, finished products, and development logic of the development life cycle simply as knowledge, but to also acquire the abilities to practice and make suggestions on standardization in regard to the optimum development standards in the development project.

Part 6 Quality Assurance

The instructor will help the students diagnose the software to be developed as a product, understand the framework of quality assurance that should be possessed by the supplier, namely the concept on the quality assurance system, and acquire the abilities to plan and enforce activities for securing quality (quality assurance activities), common to each and every stage of the development life cycle in the actual development project.

Part 7 Productivity Evaluation

Along with knowing the generally proposed measure and issues of productivity, the students are required to set up a measure regarding the applicable department, and provide the base for various evaluations of departments and projects. Specifically, the students are educated in the abilities to acquire and apply the three fol-

lowing matters.

1) Ideas on the measure of software productivity
2) The various causes that influence productivity, and whether estimation is possible
3) Projection of measures to improve productivity

2.11 Basic Systems Specialist (BSP)

To develop the abilities to evaluate and improve the efficiency and reliability of overall systems, such as overall operation performance evaluation or assistance in selecting optimum basic software and hardware for information systems, the students will acquire the expertise concerning the hardware and basic software from the viewpoints of performance, reliability, operability, and profitability, and the practical business abilities of evaluating, analyzing, and modifying them.

(1) Role of BSP

In various processes from information systems design to operation, the BSP supports the engineers for making the best selection and environment provision of hardware and basic software, along with evaluating and improving the efficiency and reliability of the entire system. The BSP supports the engineers within one's organization and engineers of third party organizations. Specifically, the BSP plays the following roles.

i) Technical consultation of hardware and basic software for one's organization and other organiza-

tions

ii) Planning and proposal for the optimum machine type and construction at the introduction of a hardware system

iii) Evaluation and selection at the introduction of basic software (includes OS and middleware)

iv) Evaluation and suggestions for reform measures on the efficiency, reliability, safety, and profitability of the entire system, including hardware configuration balance, basic software, and applications at operation

(2) Principal Duties of BSP

i) Support of system orientation plans

ii) Support of development projection

iii) Systems evaluation

iv) Support of trouble management

v) Support of resource management

vi) Technical consultation

Part 1 Hardware and Architecture

The instructor will help the students acquire the special knowledge for arranging the hardware and architecture from the functional aspect, evaluating the appropriate hardware and architecture comprehensively in the various stages, and making suggestions for optimization.

Part 2 System Software

The instructor will help the students learn what kind of technology is used in what way for each actual processing in information processing systems. The students will also be taught to understand the applicability thoroughly, by probing into each technology from the viewpoint of performance, reliability, and operation management.

Part 3 Computer Systems Configuration and Operation

The instructor will help the students master the necessary evaluation and items to be examined, and the various technical skills and techniques required in a series of processes, from computer system introduction to shiftover and operation.

Part 4 Performance Evaluation and Improvement of Computer Systems

The educational objective is to enable the students to do the following things in performance evaluation.

1) Master the logic of performance evaluation technical skills, and estimate the response time.

2) Master the work procedure for capacity planning, and estimate the necessary resources in the future.
3) Acquire the technical skills to evaluate the current performance, and present reform measures.

2.12 Systems Operation Management Engineer (SM)

To develop the abilities to understand and evaluate the operating condition of systems accurately, set operation standards, and suggest improvements, the students will acquire the knowledge and skills on the methods for operating the system safely and eliminating obstacles that prevent safe operation, the management and operation evaluation of system constituents, and the knowledge and skills concerning cooperative work with other engineers, such as operation testing and system transition.

(1) Role of SM

The way of utilization of the information processing systems is changing from batch to online, concentrated to dispersed, and in-house systems to systems extending over corporations. In addition, the systems are getting more complicated and broader-ranged, such as seen in connections between different machine types, multivendor-oriented peripherals, and network use. Furthermore, since the degree of dependency of our society on the systems are getting even heavier, advanced specialized engineers are being seeked for specializing in systems

operation, evaluation, and maintenance.

Based on such changes in the environment, the SM will play the following roles.

i) Participate in systems operation management and operation plans and design.
ii) Provide a certain and stable operation management service, and ensure security.
iii) Cost management for operating and upkeeping the system.
iv) Understand and evaluate the various resource plans and conditions of use.
v) Evaluate and suggest improvement on systems operation.
vi) Establish and inform persons concerned on the systems operation standards.

(2) Principal Duties of SM

The duties of the SM are shown below.

i) Operation management
ii) Resource management
iii) Trouble management
iv) Security management
v) Performance management
vi) Standardization

Part 1 Operation Management

The instructor will help the students systematically acquire the basic management skills required in operation management, and enable them to use these skills in operation management.

Part 2 Resource Management

The instructor will help the students systematically acquire the basic skills required in resource management, and enable them to use these skills in resource management.

Part 3 Trouble Management

The instructor will help the students systematically acquire the basic skills required in trouble management, and enable them to use these skills in trouble management.

Part 4 Systems Maintenance

The instructor will help the students systematically acquire the basic skills required in systems maintenance, and enable them to use these skills in systems maintenance.

Part 5 Security Management

The instructor will help the students systematically acquire the basic skills required in security management, and enable them to use these skills in se-

curity management.

Part 6 Performance Management and Systems Evaluation

The instructor will help the students systematically acquire the basic skills required in systems evaluation and performance management, and enable them to use these skills in systems management effectively in every stage.

Part 7 Operation System

The instructor will help the students master the basic ideas of operation management skills systematically, and apply them.

Part 8 Standardization

The instructor will help the students systematically acquire the basic skills for standardization of systems operation management, one of the "standardization" of various codes in regard to computer use, and enable them to use these skills in business and management.

Part 9 Transition and Operation Test

The instructor will enable the students to test the "shiftover and operation systems" for the system to be developed, by effectively using the various skills required at testing and at work operation.

Part 10 System Transition

The instructor will help the students systematically acquire the various skills required in system shiftover, and enable them to use these skills in system shiftover safely by using them effectively.

Part 11 Development Environment

The instructor will help the students systematically acquire the basic skills necessary for the provision and management of the development environment, and enable them to use these skills in management work.

2.13 Education Engineer (EE)

EEs are classified into three types; the planning personnel, who proposes personnel training measures and educational training systems for the technical training of IT engineers and information literacy education of users, the media teaching materials development personnel, who designs and develops the learning system and courseware, and the instruction personnel, who develops the courses and does the actual instructing. The students will acquire the practical business abilities concerning the expertise and skills demanded in each role.

(1) Role and Duty of EE

The educational engineer is classified into the following three types depending on the role and work task.

i) Planning Personnel

The planning personnel is in charge of making various plans and systems in regard to training IT personnel. Based on the administration strategies, business strategies, and informatization strategies of the one's company, he projects personnel training strategy plans and concrete training measures. The planning personnel creates various systems, such as standardized training systems and educational training systems, starting with carrier passes, and attempts in firmly establishing these into the organization.

ii) Media Teaching Materials Development Personnel

The media teaching materials development personnel designs learning systems mainly constituted by various media, and develops, enforces, evaluates and improves the media teaching materials. In the future training of information orientation personnel, effective use of multimedia, such as hypermedia and CD-ROMs will be indispensable. The media teaching materials development personnel uses various types of media to design and develop learning systems that effectively present various types of information, such as still images, animated cartoons, and sound, and efficient and effective individual learning systems of intelligent CAI, having such functions as an automatic learning diagnostics function, and then works on popularizing them. The media teach-

ing materials development personnel who plays the roles of designing, developing, and spreading such multimedia-based learning systems is a specialist, having the skills of an advanced IT engineer in media and educational development.

iii) Instruction Personnel

It is still essential to have education headed mainly by a human teacher to present the classes, and the instruction personnel plays this role. The instruction personnel carries out the work from planning and development to holding, evaluating, and improving the class, in regard to a lecture-based course.

(2) Relationship with Other Personnel

The relationship between the Educational Engineer and other personnel is shown below.

i) The planning personnel, with the image of all IT personnel in one's company in mind, projects personnel training strategies and sets up a concrete educational training system. At that point, the planning personnel receives advice in the technical aspect from the advanced IT engineers concerned.

ii) The primary duty of the media teaching materials development personnel is to plan, develop, and provide the multimedia teaching materials. And as a specialist in multimedia utilization, the media teaching materials development personnel sometimes gives technical support in developing various multimedia application systems, usually done by the Application Engineer or Production Engineer.

iii) Cooperation from the Development Engineer and technical specialist is obtained in the infra-type systems construction for education, using LAN and satellite communications.

iv) The instruction personnel is in charge of educating all personnel, but may enforce a part of the course development and lectures of various specialized technologies with the cooperation from applicable advanced IT engineers in such cases of educating advanced IT engineers.

v) When a Systems Administrator educates end users directly, EE will give support by advising on

instruction methods for information literacy education and providing teaching materials.

Part 1 Planning

The planning personnel is involved in creating various training structures suitable for each corporation. The following duties are demanded of the planning personnel.

1) Materialize the way to proceed with corporate strategies and IT personnel training for the 21st century, give suggestions to the management and parties concerned, and receive approval.
2) Based on identifying the problems in the personnel training strategy plans and present personnel training, project practical measures for IT personnel training.
3) Refer to the "Training Curricula for Advanced IT Engineer", clarify the image of the IT personnel that is sought in one's corporation, and set up a standard training system suitable to the training.
4) Build an educational training system that is optimum to the IT personnel training needs in one's corporation.
5) Pick out the chief bottleneck in proceeding with IT personnel training in one's corporation, and incorporate an effective means into the personnel training enforcement plan to deal with it.

Part 2 Media Teaching Materials Development

The following learning systems development skill is required from the person in charge of media teaching materials development as a skill for improving the effect, efficiency, and quality of multimedia-based learning systems.

1) The skill for setting up an educational training system
2) The needs analysis skill for finding the external specifications and content of the course that is suitable to the educational needs
3) The learning systems design skill for creating a systematic curriculum and designing an effective learning system, based on the analyzed needs
4) The skill for creating, evaluating, upkeeping, and improving high-quality multimedia teaching materials efficiently
5) The skill for providing, evaluating, and improving the courses

Part 3 Instruction

Planning and development, along with improvements, is required for good lectures. The following skills are required for an instructor to work on planning and development in a lecture-based course, and then implement and evaluate that lecture.

1) Plan and project the course, based on corporation and student needs.
2) Create a curriculum based on the learning objectives, develop the teaching materials (texts, visual and audio teaching materials, exercise drill materials), and prepare the course.
3) Carry out an effective presentation with the students, and effectively utilize educational skills, other than lectures, in the right place.
4) Create brochures for providing the courses, and administer them (prepare, clean up, and evaluate).
5) Evaluate the course by student reactions, and make the appropriate improvements based on the evaluations.

2.14 Development Engineer (DE)

To foster the abilities to develop basic software and middleware, the students will acquire the technical skills concerning various development processes, hardware architectures, operating systems, and human interface, along with the practical business abilities in conformity with the series of development processes, from planning and analysis to evaluation, shipment, and maintenance.

(1) Role of DE

The DE is in charge of planning and analysis of systems software, systems analysis and requirements, external design, internal design, design review, module creation, testing plans, design, enforcement, evaluation, shipment, and maintenance, and project management, and also establishes the development environment for systems development. The systems software mentioned here are described below.

i) Basic software
ii) Middleware

The DE is also in charge of developing advanced packaged products.

Part 1 Basic Techniques

The instructor will educate the students efficiently on the logic, models, and realization of the following basic techniques.

1) Construction techniques of programming language processing systems
2) Software engineering for developing large scale software systems
3) Software development techniques using human interface

Part 2 Application Techniques

The instructor will educate the students on the logic, models, and realization of the following application techniques.

1) Architecture
2) Operating systems

Part 3 Plans and Analysis

It is necessary for the development personnel with new techniques and integration techniques to lead from and take part in the planning stage for superior product development. The following practical business abilities are demanded from the DE for planning and analysis work.

1) Understand the present situation of the market and provide the demanded products.
2) Technically evaluate the possibilities of realization as a software system
3) Evaluate the possibilities of realization as a product from the business aspect.
4) Estimate the steps required for product development, and project development plans.

Part 4 Systems Analysis Requirements

At the start of systems development, it is necessary to clarify the fundamental concept and nature of the system, and set up a basic policy for the foreseen future. For this reason, the following practical business abilities are demanded from the DE.

1) Design the functions of the entire system, and decide on the objectives and development methods of performance, reliability, compatibility, shiftover, maintainability, etc.
2) Create a document (basic design package) for the product, and make all members of the company executives and information processing engineers and project promotion members concerned understand it.

Part 5 External Design

Because the systems software is used by an unspecified number of clients, the external design must be made with conscience in the ease of operation, ease of understanding, compability, and reliability. The instructor will help the students acquire the following practical business abilities in external design.

1) Positioning of external design
2) Function design package creation

Part 6 Internal Design

The following skills are required for the DE to carry out internal design accurately.

1) The skill of function division and structuralization for dividing the subsystems accurately by function, and realizing a simple and high-quality program structure.
2) The skill of detailed designing of input information required in processing and output information to be created by the subsystem, checking the file integration to be shared with other subsystems, and designing the organizations of the files to be used in the subsystem and access methods to the files.
3) Designing skill of functions that applies to reliability and safety, such as recovery, monitoring, and encoding.
4) The skill of design for securing the performance of requirements.
5) The skill of standardization and component orientation for realizing high-quality software development, along with improving the productivity of software development and simplifying maintenance.

Part 7 Design Review

The objective is to foster the practical business abilities to the students from the leading standpoint as a DE, in regard to design review, which is enforced in all processes for developing the systems software.

Part 8 Module Creation

The objective is to help the students master the points for creating a high-quality program efficiently.

Part 9 Test Plans, Design, and Enforcement

The principal objectives are to help the students understand the object, duties, and basic skill for enforcing the testing process carried out by the DE

in the actual development of systems software, and foster the abilities to execute testing accurately and efficiently. The instructor will teach the specific work duties and various technologies for executing them, and help the students acquire practical business abilities for accurate and efficient testing.

Part 10 Evaluation, Shipment, and Maintenance

The objective is to help the students acquire the practical business abilities regarding evaluation of the developed systems and the management of shipment and maintenance.

Part 11 Project Management and Development Environment

The DE, as a playing manager, is required to have the practical business abilities for diversified management types (promotion management, quality management, organization and staff management, subcontractor management, expense management, confidentiality and contract management, modification management, etc.) in achieving the project objectives, such as quality, expense, and deadlines, in the management of projects. Here, the instructor will teach the students the specific work duties for each item, and the various methods and techniques for executing them, and acquire the practical business abilities for accurate management and provision.

2.15 Microcomputer Application Systems Design Engineer (ME)

To develop the abilities to execute planning, design, and development of products that use microcomputers, the students will acquire the series of expertise and practical business abilities for microcomputer applications, from systems analysis to systems design, development plan proposal, software design, testing and evaluation, and maintenance.

(1) Role of ME

In order to develop products that use microcomputers, ME must be able to design and develop the specifications, especially of the input/output peripherals with MPU (Micro Processing Unit), to have an organic relationship between the software and hardware.

i) Take part in defining the required specifications of the microcomputer application systems, analyze the possibilities for realizing microcomputer use, and determine the internal specifications of a microcomputer application system.

ii) Project various plans, examine the conditions for enforcement, and provide and manage the environment for the development of the microcomputer application system.

iii) Direct the project members on advanced technologies, such as realtime processing, control technology, and architecture, for using a microcomputer to enforce development plans, and then reflect the required specifications on the actual system of the microcomputer.

iv) Evaluate the developed microcomputer application system.

v) Execute maintenance management on the microcomputer application system, and make use of it in the next development.

(2) Principal Duties of ME

i) Systems analysis and requirements description

ii) Systems design

iii) Development plans

iv) Software design

v) Program production and program testing

vi) Combined testing of hardware and software

vii) Systems evaluation

viii) Maintenance of the microcomputer application systems

Part 1 Microcomputer Application Systems Development Process

The instructor will help the students clarify the work for actually developing such a microcomputer application system, along with defining the specifications of the requirements and functions, reflecting the defined specifications onto the actual system, and judging how good or bad it is, and then further managing and administering each duty and resource.

Part 2 Microcomputer Application Systems Software Technology

The instructor will help the students understand the microcomputer application systems as a collection of resources comprised from hardware and software, and enable them to direct the design and manufacture of the software. The objective is to help the students acquire the abilities to distinguish the resource character accurately, select the resource, and trade off these selections and allotments, and the ability to create the necessary resource with the software.

Part 3 Microcomputer Application Systems Hardware Technology

The objectives are to understand the computer logic configuration and systems architecture, and acquire the skills to design and produce the architecture for the microcomputer application systems on the condition that software technology is used.

Part 4 Realtime Systems Construction Technique

Most microcomputer application products must react instantaneously and sensitively to occurring events. The realtime systems are constructed for executing the processes that react instantaneously (within a fixed time limit) to the events occurring from the outside world. The objectives here are to help the students acquire the technologies for constructing realtime systems, and enabling them to enforce systems design and production.

Part 5 Microcomputer Control Technology

In order to analyze and design the microcomputer application systems from the viewpoint of control logic, the advanced IT engineer must acquire and be able to apply the basic logic on control and the latest variety of new

control systems. Furthermore, besides these control technologies, it will be necessary to acquire various component technologies for control through mechatronics, such as sensors and actuators, and determine the appropriate control system. It will also be necessary to gain an extensive range of application techniques regarding the control for it.

Part 6 Microcomputer Application Systems Development Support Technology

The ME must acquire the following expertise concerning development support technology.

1) The ability to construct and evaluate the systems development environment for the development of a high-performance microcomputer application systems.
2) The ability to select the techniques for improving quality in analysis and design in the development of microcomputer application systems.

Here, the objectives are to take up the technology in connection with such developments and verifications, and acquire the means for developing high-performance microcomputer application systems.

2.16 Systems Administrator (SAD)

To develop the abilities to build information systems and promote end user computing on the users' side, the students will acquire the necessary knowledge and skills for improving and raising the level of the present state of work, along with the practical business abilities concerning the use and implementation of various tools and software packages.

(1) Role of SAD

The SAD possesses a certain amount of knowledge and technologies in information processing on the side of end users, and promotes and enforces informatization within a department or group from the standpoint of end users. Specifically, the roles of the SAD are as follows.

i) Promote end user computing (EUC).
ii) Construct and support a part of the information system within a department or group.
iii) Present the opinions and requests of end users to the providers of information systems.
iv) Operate the information system and provide the environment for

system utilization.

In this curriculum, the roles of the SAD and senior system administrator (Senior SAD) are supposed to be divided as follows.

i) The Senior SAD is mainly in charge of the plans for informatization, planning, and management required in the departments. The SAD is in charge of constructing (or partial constructing), supporting, and operating the information system within a department or group.

ii) The Senior SAD is mainly in charge of setting the standards, such as design, operation, and management. The SAD mainly carries out the duties according to the standards.

iii) Besides this, the SAD promotes informatization within a department by consulting with and being directed by the Senior SAD.

(2) Principal Duties of SAD

The work extends over a broad range, from small scale EUC to participation of end users in the development of organization's core business application system. The SAD's duties are mainly involved in EUC.

Part 1 Work and Computers

The SAD must demonstrate leadership in constructing the best end-user-oriented systems. And in regard to core systems that extend over departments or an entire organization, the SAD must consider how they should be used effectively in the flow of work while keeping in close contact with providers, and attempt in aggressive promotion of informatization. Here, the objective is to acquire the following matters, along with the meaning of introduction toward the entire curriculum.

1) The ability to understand the flow of work systematically

2) The general knowledge of information systems

3) An attitude for making full use of the skills and knowledge mentioned above and always thinking of how to improve the work procedure

Part 2 Involvement with Core Business Application Systems

When a end user department cooperates in core business application systems construction, the SAD, as a leader for promoting informatization, will be required to have the various skills noted below as indispensable

skills. Here, the greatest educational objective is for the SAD to be able to acquire the basic skills and suggest and review systems that can be used effectively in the information systems department.

Part 3 End User Computing (EUC)

End users will be required to use the merit of distributed information systems to a maximum. To realize this, it will be necessary for end users also to ready the basic skills concerning the construction, operation, and utilization of information systems so that simple information systems conforming to the needs in each department can be applied in their work. In such a situation, the SAD must play the role of the leader. The instructor will help the students acquire the following knowledge and skills.

1) The knowledge and skill regarding personal computers with the focus on EUC.
2) The knowledge and skill concerning especially spreadsheet software and database software
3) The information technology in personal computer environment use
4) The knowledge for realizing a comfortable office environment from the aspect of informatization

Part 4 System Environment Provision and Operation Management

To promote EUC, the SAD must have the knowledge and skill for introducing and installing hardware and software, providing system environment and operation management. Therefore, for the promotion of EUC, the SAD must have the necessary knowledge and techniques for carrying out the actual work smoothly, and use them in practice. However, performance management, trouble management, and security management must be carried out on the condition that it is based under the direction of a specialist, such as the Systems Operation Management Engineer (SM). Therefore, the focus is on acquiring the necessary knowledge and skill from the standpoint of support.

Part 5 Expression Skills for EUC Progress

Expression skill is an indispensable basic technology to the SAD. The greatest educational objective here is to help the students acquire the basics of expression skill, specifically to help the students learn on presentation skill, how to write documents, and us-

ing multimedia tools, and apply these accurately in practical business.

2.17 Senior Systems Administrator (Senior SAD)

To develop the abilities to plan improvement and sophistication of the present state of work, and promote basic information systems and end user computing of one's own section in cooperation with information system sections and other user sections, the students will acquire the practical business abilities concerning the necessary knowledge and skills for proposing informatization plans of corporate application systems and constructing and operating the systems.

(1) Role of Senior SAD

The senior systems administrator (Senior SAD) is a person on the side of users, possessing advanced knowledge and technology in both aspects of information processing and practical business affairs, and promotes and enforces informatization within one's department as leader. The Senior SAD plays the following roles.

i) In consideration of the connection with the information systems department and other practical business departments, give suggestions for improving the work of one's department and project in-

formation orientation planning.

ii) Present the user's opinions and requests to the information systems provider.

iii) Promote end user computing (EUC).

iv) Provide the operating environment and utilization environment of the information system as the leader on the side of users.

(2) Principal Duties of Senior SAD

The duties of the Senior SAD extend over a broad range, from small scale EUC to participation of users in development of organization's core business applications. At times, the Senior SAD is a leader of informatization of a specific section, and at other times, as a representative of users, carries out the key work of informatization.

Part 1 Business System Improvement Project Proposals

It can be thought that the mainstream of future information systems will be a complex system, in which user-based systems that fit best with the work concerned, and basic work systems that extend over sections or the entire organization, are connected organically. Future users are demanded not only to just settle at using provided information systems, but to have an attitude for promoting improvement, with the conscience for planning and constructing on one's own. The Senior SAD must play a central role in this circumstance, and have the strength to promote constructing and improving information systems in one's department, based on the latest technologies, after understanding the work systematically.

The instructor will help the students acquire the following.

1) The ability to understand the mechanism of one's work, and project plans for improvement

2) The knowledge required for applying EUC for work improvement

3) The ability to understand the information systems of the entire organization, and make suggestions for improvement, based on the requests from one's department

Part 2 Management for Constructing Information Systems

The Senior SAD plays the role as leader for information systems construction, especially in promoting

EUC in the user's departments. The system skills required for EUC promotion are widely diversified, but it is important in promoting the constructing and operation of systems to receive cooperation from information systems departments and specialists. Therefore, the students must acquire the various skills mentioned here.

1) User demand analysis skill, with the precondition of EUC
2) System design skill, including the selection of hardware, software, and network for EUC
3) Review skill in each process of system orientation, from planning to operation of the information systems
4) Testing and acceptance skill for evaluating the system created with EUC
5) Skill for executing systems operation smoothly, and projecting organizations and systems for promoting EUC

Part 3 Management for Information Systems Use

The Senior SAD must have a broad view over the entire organization, while promoting informatization from users' standpoint at all times, and is in possession of the key for future informatization. Namely, the Senior SAD's duties are on the spread of system use and work efficiency. Here, the objective is for the students to acquire the following items necessary in promoting information system use.

1) Meaning of information creation
2) The skill to process the data to the applicable form, and then apply it
3) The knowledge for creating an easy-to-understand manual for promoting information systems use
4) The knowledge and skill required for dealing with information systems operation from users' standpoint
5) The knowledge and skill required for enforcing the promotion of use

III. Principal Information-oriented Education Support Projects

1. New 100-School Networking Project

The Ministry of International Trade and Industry (MITI) enforced a 100-School Networking Project from 1994 to 1996 together with the Ministry of Education, Science and Culture, as a measure in education informatization, one of the policy program within the "Program for Advanced Information Infrastructure" of MITI. This project, as a trial for using and applying computer networks in the primary and secondary education scene, had computers installed in roughly 100 elementary and junior high schools nationwide, with the object of demonstrating the possibilities of education and learning that go beyond the conventional framework while making full use of advanced computer and network technologies.

From April 1997, the Phase II of the project started with the three main pillars of "Globalization", "Area Collaboration", and "Sophisticated utilization of school networking". The actual planning and management of this project is undertaken by the Information-technology Promotion Association (IPA) and the Center for Educational Computing (CEC).

(1) Globalization

- Cooperate with overseas educational organizations to promote international understanding and education on language, through the international exchange plans proposed by Japan that use information exchange and networking between schools, or similar plans in collaboration with other foreign countries, and then clarify the technological problems and countermeasures, educational effects, and problems in the process.
- Seek various measures to solve the issues in language, technology, and knowhow that are necessary for international exchange.
- CEC will act as the contact organization of international exchange activities between Japan and overseas.

(2) Area Collaboration

Based on the knowhow of the schools cultivated through the 100-School

Networking Project so far, several types of regional education network operations models will be created. The regional characteristics will be added into the closest model, and cases of network education practice and technical problem-solving advice will be provided to promote the expansion of future educational network use in the region.

(3) Sophisticated Utilization of School-Networking

The Research on the future Internet education will be conducted, through technology-oriented network utilization experiments, anticipating future technological trends, and education-oriented network utilization experiments.

2. Nippon Telegraph & Telephone Corp. (NTT) "Konet Plan"

Common carriers that represent their countries, such as AT&T of the U.S. and BT of the U.K., are devising special measures to connect schools by Internet. NTT, also not an exception, is carrying out a support project called the "Konet Plan" with the cooperation from the Ministry of Education, Science and Culture. Konet stands for a network for children. "Ko" means "child" in Japanese. The Konet Plan presently supports the following Internet connection services for 1,000 schools.

(1) Consultations on Internet Connection and Use

1) The series of operations for Internet connection, from selecting personal computers and software to be used to setting communication devices
2) Internet access provider selection
3) Procedures for using the WWW and electronic mail, and homepage creation techniques necessary for sending out information from the school

(2) Support Activities for Creating An Environment for Internet Use

1) Provision of ISDN communication devices free of charge for creating an Internet environment of dial up connection

2) Provision of software free of charge for classroom use

(3) The Provision of Contents for Pleasant Internet Use

1) Provision of homepages that introduce world and regional information

2) Provision of mailing lists for teachers and students to exchange information with each other

In the Konet Plan, a "Konet Promotion Council" is set up to promote the exchange of information and sponsor various projects on the network, such as independent research contests, over the Internet.

In December 1997, NTT announced the expansion of Konet Plan applicants from the present 1,000 schools to a roughly 40,000 elementary, junior high, and high schools nationwide, starting from April 1998. Specifically, the NTT group will contribute a total amount of 1 billion yen to municipal governments and give human support, such as giving consultations for building an environment, installing for internet connection, and holding training seminars for operation. Future "Konet Plan" promotions will be held in cooperation with the ministries and government offices, and contribution to school multimedia orientation will be taken in together with the education commissions and education centers of each municipal government. In addition, NTT will appeal broadly to corporations and organizations to take part in the "Konet Plan Promotion Council."

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