(AEN Project 2005)

High utilization research committee of IT regarding “Knowledge”

March.2006

e-Learning Consortium Japan

4.0 Activity Overview of “Knowledge” Committee

4.0.1 Activity objective

In order to contribute the development of “Knowledge emergent type society” faced the activity of the committee, this committee will review the e-Learning passed over 10 years since release in the market, will escape from the frame of learning and human resource and will study of what the committee should do in order to plan the creation of “Knowledge society” that’s foundation to support future Japan.

In the last time, since the concept of “Knowledge” system and its market was defined, the committee will activate further concreted work this time.

4.0.2 Committee activity overview

(1) Constituted member of committee

This committee invited professor Okamoto of Graduate School of Information Systems, the University of Electro-Communications as chairperson, selected 9 members in total from vendors and consultants and 9 members from the Ministry of Economy, Trade and Industry.

Table 4-1 Committee constituted member

Role	Name	Company and organization
Chairperson	Toshio Okamoto	University of Electro-Communications
Member	Kenji Itoh	Mizuho Information & Research Institute
Member	Toru Imamura	Sybernet System
Member	Shinzi Ueno	Fujitsu
Member	Hidekuni Komatsu	NTT Learning Systems e-Learning Consortium Japan
Member	Hideaki Takeda	National Institute of Informatics
Member	Kyouhiko Nomura	Fuji Zerox
Member	Kenji Hiramoto	Woodland
Member	Shuji Miyazawa	Learning Architecture Institute
Secretariat	Itiro Osawa	METI
Secretariat	Naomasa Kawagoishi	METI
Secretariat	Maki Kikuta	METI
Secretariat	Tatehiko Usui	e-Learning Consortium Japan

(2) Overview of committee activity

The activity was started from October 2005, and completed in end of March 2006. During the period, 5 conferences ware held every month, and the report was summarized. The activity during the period is as follows:

① Opinion exchange between members at conference
② Overseas surveillance (USA survey/Europe survey)
③ Small lecture by learned person (to learn new technological trend and concept method)

(3) Conference description

・First conference:

New member was participated, natural behavior, utilization method, of “Knowledge”, etc. were studied by free discussion and images of all members were matched.

・Second conference:

A member Takeda introduced the utilization system of “Knowledge” by the theme of “Aiming at community web”. Furthermore, an inspection report of e-Learning 2005 participation and North America e-Learning utilization site were performed.

・Third conference:

A member Nomura introduced concrete case of creation of “Knowledge” by the theme of ”Community of practice”. At the same time, Mr. Kayama of Senshu University explained the status of Learning Grid in Europe and England by the theme of “Development trend of Learning Grid”.

・Fourth Conference:

The chairperson reported the European surveillance results. At the same time, all members will study item, possibility, etc. regarding the system of “Knowledge”.

・Fifth conference:

All members studied constitution and description of the report.

(4) Overseas surveillance report

・USA surveillance:

In order to investigate the advanced utilization case, the committee visited and investigated each university and enterprise in Canada (participated in e-Learning 2005 in Vancouver in October 23 – 30) and USA.

・Europe surveillance:

In order to investigate mainly LearningGrid, the committee participated in International Conference (Celda) in Porto, Holland in December 11 – 23, and visited CLC in England.

4.1 Analysis of “IT basic strategy regarding knowledge” in overseas and Japan

4.1.1 Background and changes of strategy

The strategies viewed from civilian side in USA are many by fields such as education and labor, and integrated strategy of services has not been searched. Only the integrated strategy regarding R & D exist. Conversely, Europe and Japan have searched and reviewed the integrated strategy regarding service used IT at almost same timing. Among these, R & D are included.

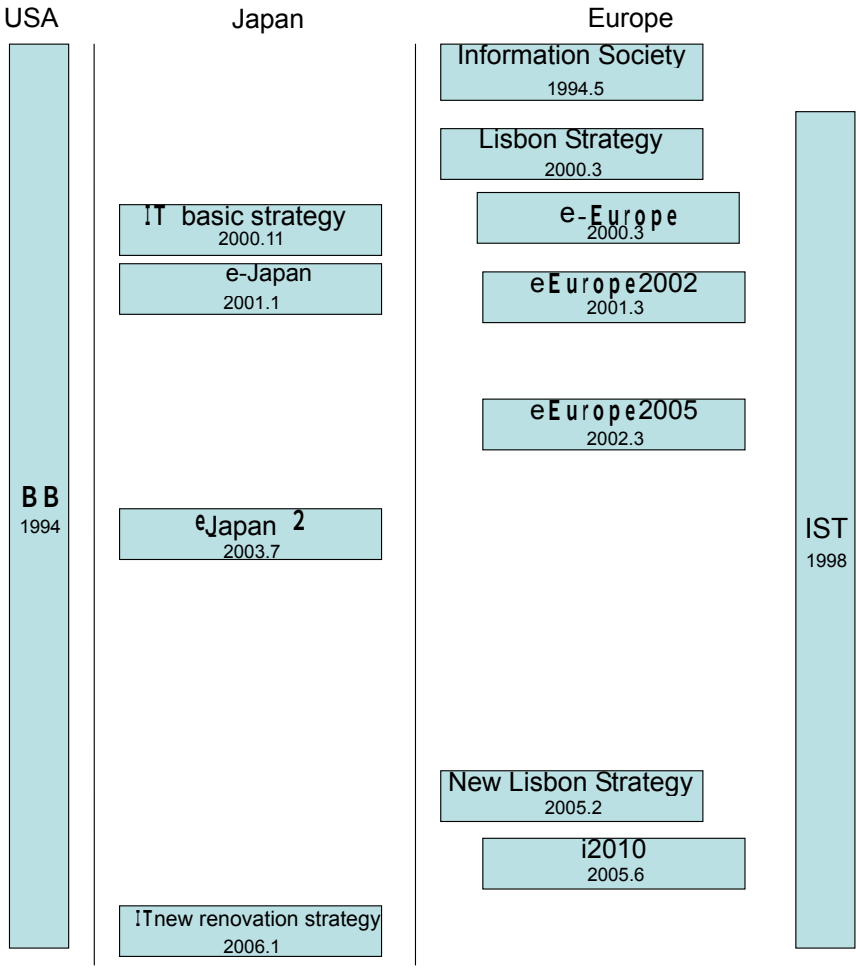

Figure 4-1 Changes of strategy

These strategies are to be observed from viewpoint of “Knowledge”.

The United States are promoting R & D for management and use of information rather than the knowledge society. This is one of pole of country’ R & D polices, however the research has been performed by the frame of “Human, computer, instruction and information management” among research and development strategies. Since the technology regarding information and knowledge in military also becomes important, the research of fundamental technologies such as large volume information processing, information management, decision-making support, artificial intelligence, etc. However, generally, as shown in Google, etc. regarding the knowledge, the research at civilian enterprises have been successfully

progressed.

Europe started from the Bangemann report in 1994, and has been promoting the strategy that axis is placed on information society and knowledge society as a link from that time. Although they have culture that the knowledge is important, the middle ware field that handles the knowledge as same as Japan is, way behind from the United States. However, International software such as request analysis software, 3D CAD has been released.

Japan has been using the language of knowledge society by books etc., and has been starting to reflect to policy in current year, by taking “Knowledge” into the e-Japan strategy. However, Japan has partially focused to education and content, and has not systematically tackled with entire “Knowledge”. Only partial enterprises centrally tackle with information management and knowledge management, high functional software regarding knowledge mostly depends on overseas.

4.1.2 Analysis of Japanese strategy

Before evaluating overseas strategy, the Japanese strategy that is the premise is arranged.

(1) Strategy evaluation up to date

Tackling of e-Japan 2 that has been progressed for targeting to 2005, is to be important field of knowledge and human resource upbringing as well as work where the knowledge is exhibited, has been promoted as important field.

The knowledge area included human resource upbringing and content has been performing the following policy to activity.

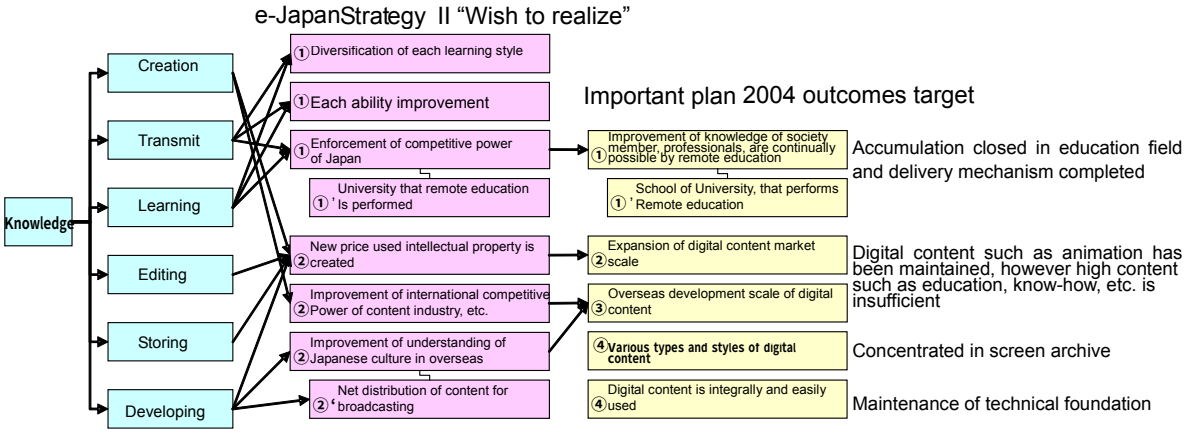

Figure 4-2 Policy of human resource upbringing and content relation

All activity areas have not been promoted, however the learning mechanism has been maintained by this tackling in not point but face. However, there are still issues such as that opportunity of re-learning after employment has not been seamlessly supplied.

Furthermore, production content environment such as screen has been maintained, however like as contents in industrial fields, the environmental maintenance regarding intellectual content handling that the description is changed with time, has not been performed.

In social environment, diversification and web orientation are increasingly progressing, and it is considered that new intellectual support mechanism that cannot cover by conventional remote education and accumulation of digital archive, will be required. If viewed from industrial competitive power enforcement, architecture of intellectual foundation for industry is urgent issue. Furthermore, the tackling regarding the work that is a scene to use as well as to create knowledge, has been performed as follows when viewed from every each activity.

Figure 4-3　Policy regarding work

In order to support the enterprise activity, mechanism to completely use and to let the knowledge grow, is required.　As to the human resource upbringing, shift to “Management by the face of that current skill is grasped” but not “Gate management by qualification” is suggested, and it is god tendency that human resource management concept has been changed. However, Maintenance of mechanism for sending such knowledge foundation and human resource has not been almost performed. In future, even the telework that is considered to be used on the knowledge foundation, the telework that is only connected to head office is promoted, and the business start is only promoting. In new work environment of mainly individuals such as Virtual Corporation, the social infrastructure maintenance regarding knowledge co-ownership for individual ability maximization and team total power exhibition, is important.

(2) IT new revolution strategy

Based on the e-Japan evaluation, next strategy was studied and was released in January 2006 as the IT new revolution strategy.

a. Basic doctrine

In the new strategy, a point that knowledge and information have been importance is described in the beginning of strategy as follows as strategy background up to date.

> Ⅰ Basic doctrine
> 1. Objective
> In order that our country realizes continued economic prospect and plentiful people life in 21 century, it is necessary that the social foundation that 20 century was maintained as premise, is convert to the status for new knowledge creation type society that information and knowledge becomes source of value added. Based upon these recognition, ….(emission) ….. genuine tackling to IT revolution was started.

Furthermore, the following target form is described in latter half.

In future, such IT characteristics should be effectively used with user’s viewpoint to make an effort improvement of people life and industrial competitive power and to tackle with to revolute a large social issue that Japanese society has, and the outcomes should be transmitted to world. Due to that, the form of our country should aim at is, the first, “the Ubiquitous network society that anytime, anywhere, whatever and anyone can be used” should be realized by paying attention for security maintenance, privacy protection, etc. And the second, with the above doctrine, the advanced IT nation who has world highest infrastructure, potential usability and technical environment should be continued.

Furthermore, the following change to IT society by these realization is declaring.

The IT strategy headquarter will complete renovation leading in the world IT in 2010 by certainly performing the strategy, and declares that our country will change the cooperative IT society that continuous development is independently possible and anyone can subjectively participate in social activity.

As can be understood from the above doctrine, it is obvious that “Information”, “Knowledge”, “User interface” and “Independence” that the importance especially becomes high among recent information technologies, is a key component of this strategy.

b. Concrete policy

When looking at the concrete policy, the basic strategy in Japan consists of 3 policy groups such as “Policy group that issue is solved by IT”, “Policy group of foundation maintenance” and “Policy of International contribution”, however if part relating to the knowledge is extracted from the strategy, it becomes the concrete item on left side as shown in figure 4-4.

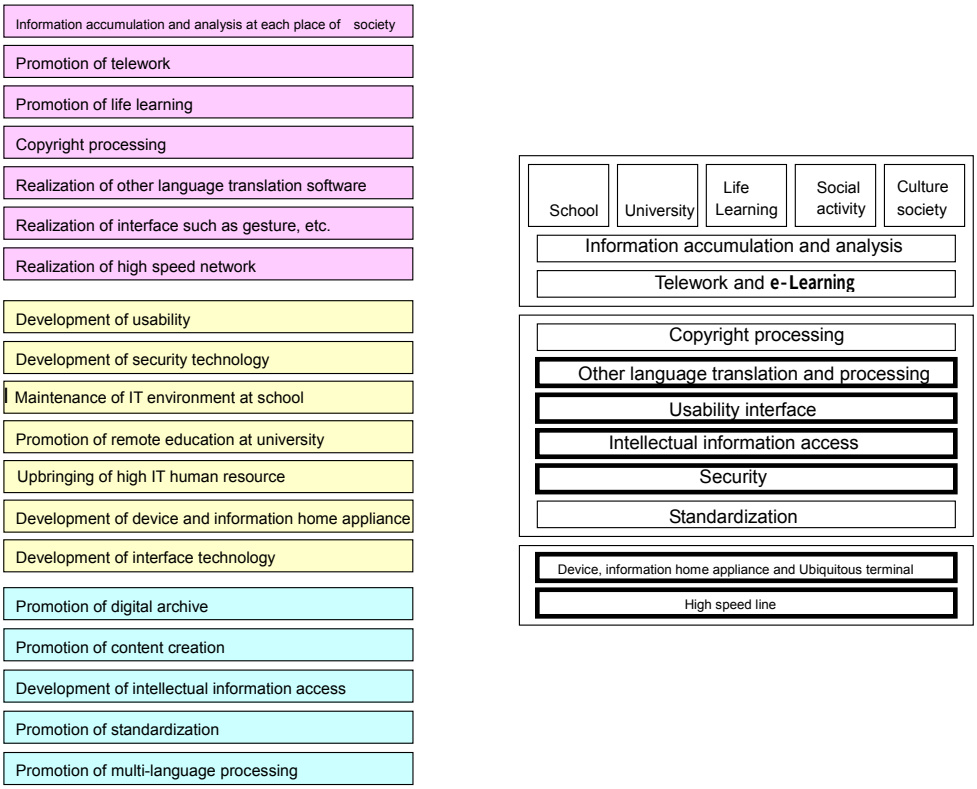

Figure 4-4 Concrete policy

It looks covered, however individual technology and target are described as pin point, and it is therefore actually not covered.

4.1.3 Analysis of overseas strategy

The tendency of overseas “Knowledge” is observed from strategy face.

(1) Analysis of USA

USA has provided the NETWORKING AND INFORMATION TECHNOLOGY RESEARCH AND DEVELOPMENT PROGRAM as the research and development basic program. The main thing is investment to large scale project and basic research. The axis is the following tackling, and the part regarding knowledge is mainly part of the Information Management.

- High End Computing Infrastructure and Applications (HEC I&A)
- High End Computing Research and Development (HEC R&D)
- Coordinated Implementation of the Federal Plan for High-End Computing
- Cyber Security and Information Assurance (CSIA)
- Human-Computer Interaction and Information Management (HCI&IM)
- Large Scale Networking (LSN)
- High Confidence Software and Systems (HCSS)
- Social, Economic, and Workforce Implications of IT and IT Workforce Development (SEW)
- Software Design and Productivity (SDP)

The information management has been performing substantial research at the national level, and concerning the part of knowledge, civilian enterprises are aggressively tackling. Especially, they are researching an developing database, data mining tool, analysis tool, retrieval tool, etc., and selling in the market. There are the flow that is researching with US military and is selling in the market and other flow of research center group that was researching with vision from initial stage of computer development. Furthermore, there is a large tidal current arisen from university venture, and R & D are performing by the diversified routes.

(2) British strategy: Harnessing Technology Transforming Learning and Childern’s Services

In Britain, “e-strategy towards ‘a common digital infrastructure to support transformation and reform” summarized by DfES（Department for Education and Skills）every year, is basic axis, and the following is to be supplied:

· Online information service integrated for all civilians
· Integrated online individual support to children and learners
· Cooperative approach to learning activity every individuals
· Quality ICT training and support package for practician
· Leadership and development package for organization ability regarding ICT
· Common digital infrastructure that supports shifting and renovation

The responsibility is concentrated in auxiliary organs of the DfES called the Becta（British Educational Communications and Technology Agency）and the JISC（Joint Information

Systems Committee）.

The Becta was firstly in charge of design and development of education exclusive portal site NGfL Portal that was established with the DfES budget in 1998, who was in charge of policy regarding education and job training at center, and with strategy progress, the activity areas were expanded. Currently, they are directly involving in many e-Learning businesses in Britain such as: e-Learning materials used for educational institutes and inspection validation through procurement of ICT equipment; playing comprehensively leadership role in the NGfL initiative; the existence and activity features the e-Learning policy in Britain that is an excellent in Europe, and they are extremely unique body.

Further, the JISC is supplying opportunities used ICT for strategic guide, advice, teaching, learning, investigation research and management to educational institutes after higher education. The JISC has committees: 1). Organizational Support, 2) Content Services, 3) Integrated Information Environment, 4) Learning and Teaching, 5) Networking and 6) Support of Research, and is summarizing the JISC Information Environment. While, besides JISC, they are supporting the CETIS (Centre for Educational Technology Interoperability Standards) who summarizes e-Learning Framework. (CETIS is performing by the University of Bolton) The JISC is promoting the e-Framework for Education and Research with JISC Information Environment and e-Learning Framework integrated.

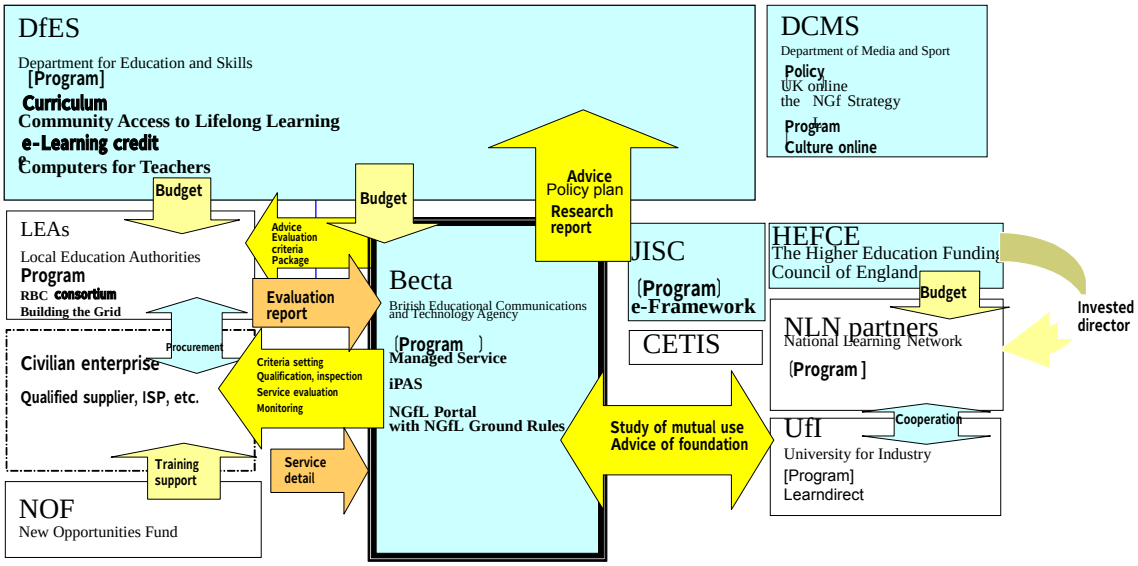

Figure 4-5 “Knowledge” related activity body in Britain

(3) Strategic analysis in Europe

When looking at the European strategy, Europe is only professing to realize the knowledge society, and the items regarding the knowledge are listed as large items.

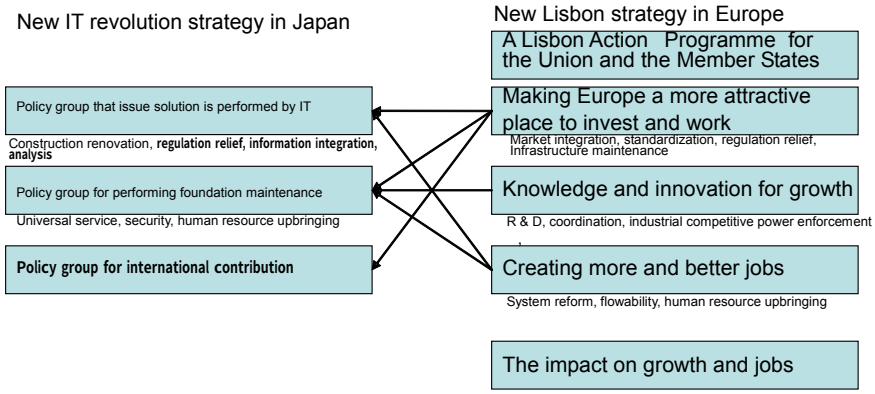

Figure 4-6 Strategy comparison between Japan and Europe

New Lisbon strategy in Europe has been developed as i2010 as well as concrete action plan. The following figure shows the essence of new Lisbon strategy in left, the essence of i2020 in center and the figure technically re-constituted in right respectively. (Among i2010, items shown with dotted line have been discussed but have not fixed as pole)

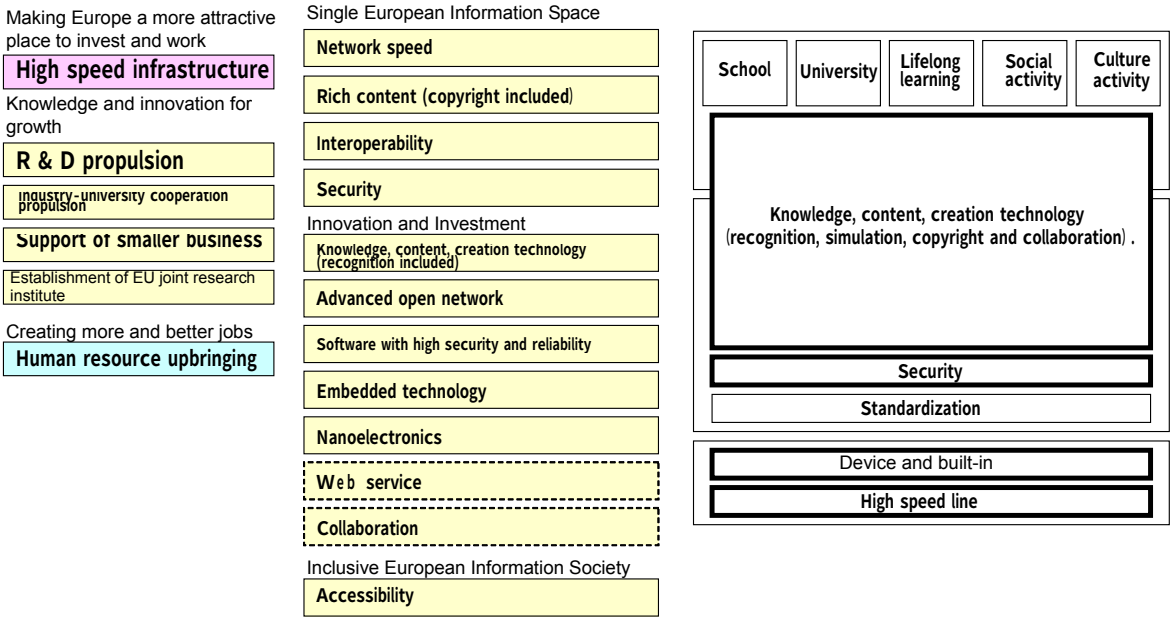

Figure 4-7 Technical development of Lisbon strategy

Application and basic technology have been agglutinated, and knowledge, content and creative technology have been tackled as an important issue.

4.1.4 Japanese strategy issue viewed from overseas strategy

Military and civilian are the nucleus of R & D in USA, and same tackling against weak domestic information cannot be expected. Therefore, by comparing with that construction is similar to Europe who is leading industrial fields, issue is to be arranged. The Japanese strategy is constituted with the style that suggestion from agencies are summarized, while it is considered that creating by top down from mission makes this strategy differed in Europe.

Most insufficient thing in Japanese strategy is middle ware technical section related to information handling. Further, there is problem from position of the strategy management. Even declaring the knowledge and collaboration by basic doctrine of strategy, correspondence to knowledge management and delivery parts is small. In addition, the mechanism of collaboration regarding cooperation has not been handled. A large problem is that surface tackling of cross-industry and cross section to eliminate slivers is main subject.

Concretely, enforcement of high analysis of medical information and information analysis in the strategy of utilization has been aimed at, however the technical support has not been provided. The topics that knowledge and content are involved as the basic technology, are only information access technology of retrieval (analysis included) and multi-language conversion tool. However, in order to highly utilize information at utilization scene, various technologies that suitably manages such information and uses, is required. Such insufficient part is problem. Furthermore, rendering tool and simulation for creating the content are obviously insufficient, however it has not been picked up as problem.

When the Japanese strategy is arranged, the interface and infrastructure are world top level, however the tackling of knowledge and content areas are omitted. Europe is catching up regarding interface and infrastructure as well as is preponderantly tackling with knowledge and content areas which are weak tackling in Japan.

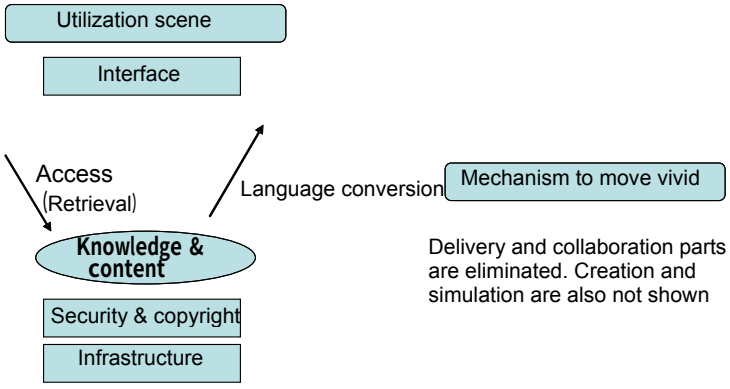

Figure 4-8 Issue points of Japanese strategy

Furthermore, When looking at this field by product level, in spite of the mainstay function,

the Japanese products have not occupied market in all fields. (Europe also occupies partially)

This is not problem closed for industry that the information industry is facing with. Even present time is favorable industry, if maintenance and upgrade are restricted by overseas, the neck will be chalked. Animation is also favorable as export industry and is positioned at the strategic field, however if it is considered that the core software for animation creation is depending on overseas, it is considered that middle and long period countermeasure is required.

However, this issue is considered to be solvable by planning and managing proper strategy. Since the advanced users are in Japan, like as that manufacturers of Toyota and others raised the manufacturing machines to world top level, domestic software is also considered to be recoverable by skillfully recycling the request from manufacturers to middle ware. The content industry is also same, and the mechanism that software industry realizes the animation industry requests through joint works, is required. However, since financial support to the software industry has not been sufficiently functioned, it is considered that only fund support and scheme creation will not function. The important point to success is to let the software industry have conscious that targets world conquest and to let have them plan the consciousness renovation.

In taking into consideration such status, it is necessary to reform the comprehensive strategies regarding information management and knowledge management as that IT new renovation strategy, intellectual property strategy and technical strategic map are to be enforced.

4.2. How to exist “Knowledge” system

4.2.1 What is knowledge system?

(1) IT high utilization image regarding “Knowledge”

Here, as premise of the aforementioned current status recognition, it was taken a serious view of that the information strategy that became important strategy for management strategy in new value creative economy also gave a large change to the enterprise achievements.

Enterprises quickly grasp the change of role that played among high information society, and is required to increase the profit by raising the enterprise value through not only indoor but also outdoor strategic communications. Due to that, the strategy for information will be asked .

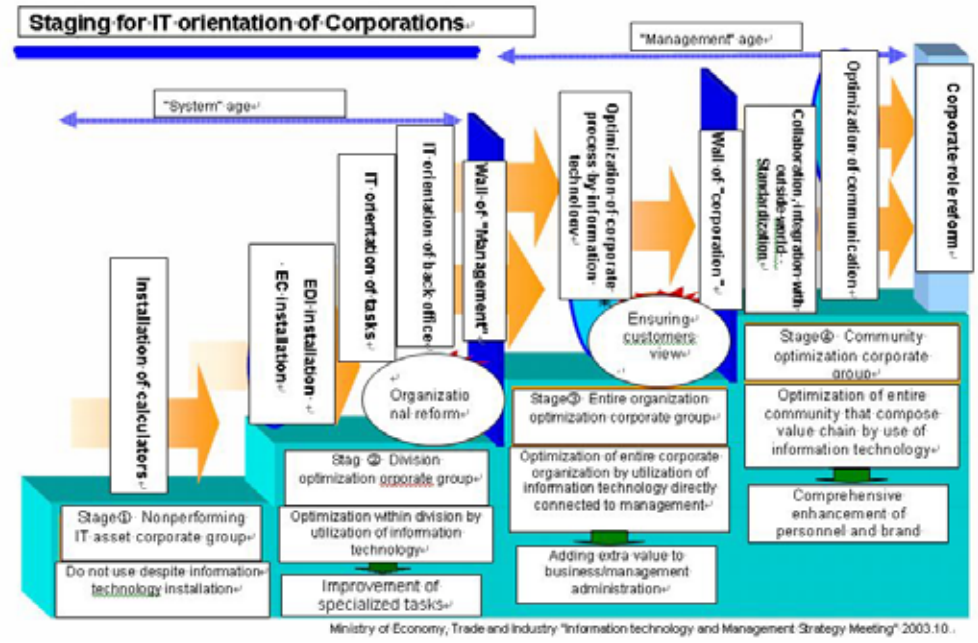

Figure 4-9 Staging of IT orientation

That is to say, it has been becoming important in the value creative economy that the value added information is obtained and how it continues transmitting.

In the e-Japan strategy Ⅱ of government, the “Knowledge” has been picked up as one of important fields with the point consciously, however the correspondence of “Knowledge” makes problem solution concentrated to the human resource upbringing except for the intellectual property strategy.

While, in the commerce white paper, the asset value in the value creative economy has been defined as follows:(Reference: Commerce white paper 2004)

① Regarding innovation

② Regarding human resource

③ Regarding organization

If looking at these points, it is obvious that if the “Knowledge” issue is enforced to measure only by focusing on the human resource, it does not become solution.

(2) Suggestion of “Knowledge” system

From these current status, modeling to turn new “Knowledge” cycle is required.

Therefore, from these viewpoints, the IT high utilization image regarding the “Knowledge” that should be in future as shown in Figures 4-10, 4-11, and 4-12 was elaborated.

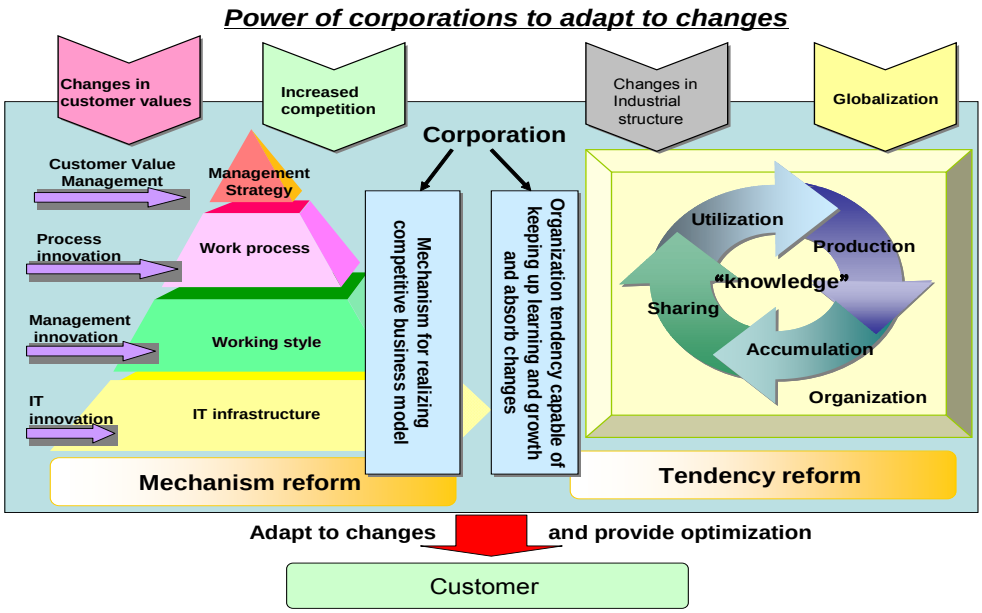

Figure 4-10 Enforcement of change Vs stress of enterprise

Figure 4-10 is imaging the form that took a serious view of correspondence to environmental change in the value creative society and especially change regarding the value creation.

In the environmental change, the change of value consciousness of client that social change in the information society already mentioned will bring and expansion of competition between same businesses, between different businesses and between other countries called “Large competition era” that borderless will bring, will occur worldwide scale. That will give a large impact to industrial construction that was cultivated in the industrial society, and change to new industrial construction is enforced. In order to survive against such severe environmental change and to realize the enterprise strategy with development, it is necessary to largely make correction the inside construction. Especially, in that the information value is largely changing the management strategy, it is necessary to always pursuit high value added orientation, high value added orientation as innovation power corresponding to change and high value added orientation as organization power.

In addition, like as EA being highlighted in the electronic government architectural program, it is necessary to dynamically employ “Mechanism changes” such as integration of management strategy and information strategy, quickness of optimization, etc.

As the result, it is necessary to keep continuing new business model.

As to the organization power and human resource, the model to turn “Knowledge” cycle and it acceleration are required. “Knowledge” cycle is turning in the sequence of Creation →accumulation→co-ownership→utilization. Acceleration of this cycle and high value added orientation of human is becoming the issue.

Conventional models such as that human resource upbringing and learning are performed by setting time and place time by time and that instruction and co-ownership after information was arranged and systemized, it cannot win competition in severe change era or severe speedy information consumption.

Typical school education as conventional education training models are that education turns to self-objective orientation, that model may be used sometime future and that it cannot be used in the value creative economy.

In utilization of “Knowledge, the knowledge management became boom in the past, and it was started to propagate before e-Learning. However, as shown in figure 4-11, it has been arranged as the style of document control, enterprise information portal (EIP), retrieval engine and integrated knowledge management, however education and learning have not captured as its element.

Figure 4-11 Coverage range of KM

Human resource upbringing, learning and e-Learning has thereafter progressed based on IT application in conventional e-Learning as other field, however it has been becoming necessary to integrally locate in the “Knowledge” cycle before inviting the value creative economy.

(1) Definition of “Knowledge” system

As the mechanism using “Knowledge” in these environments, the following model is suggested.

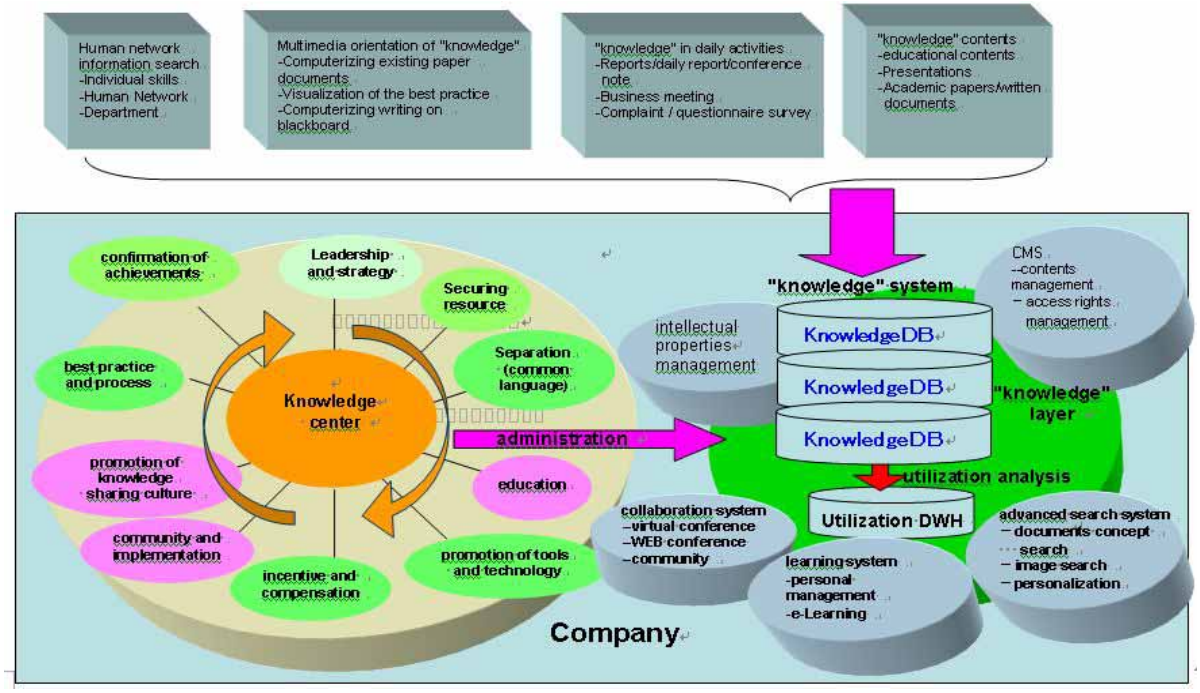

Figure 4-12 Utilization system way of “Knowledge

The function of “Knowledge” utilization is defined as unit. It is expected that these are

networked and integrally used.

The following explains individual function:

① Management system of knowledge

The management system of knowledge performs utilization analysis together with data warehouse for utilization based upon the knowledge, and includes a link of functions to proceed accumulation and co-ownership of the knowledge.

② Collaboration system

The collaboration system is infrastructure and communication system for proceeding co-ownership of the knowledge, and includes virtual meeting, web meeting and virtual community.

③ High information retrieval system

The high graded functions such as document retrieval, language retrieval and web retrieval, etc. are included.

④ Learning system

The learning system is considered to be mechanism that the learning system included from courseware systematically arranged till learning object and contents will supply. That is to say, if observing from the management system, it is located so that the information to be accumulated and to be co-ownership, can be systematically and efficiently learned and held in common.

From this scene, the information and contents to be required differ depending on individual and environment, and it is necessary that they are integrally managed.

⑤ Content management system

This is the function required to integrally manage the contents however also has common function with the learning system and the knowledge management, and it is necessary to separate for the function integration.

⑥ Knowledge center

The knowledge enter is separately provided as the information collection function for the knowledge management, and maintenance of the foundation that knowledge exchange can be freely performed through network, is required.

Furthermore, as shown in Figure 4-13, if the network that the network of “Knowledge” connected many units of the knowledge highly developed based upon the unit function and the market of “Knowledge, can be formed, it will play an important role as the foundation of value creative economy, investment motivation to individual and enterprise intellectual activities would be induced.

In the policy of “Knowledge” field of the e-Japan strategy Ⅱ, it is considered to be important that such “Knowledge” network or “Knowledge” market should be urgently architected as the national strategy aw well as the value creative economy foundation in medium and log period.

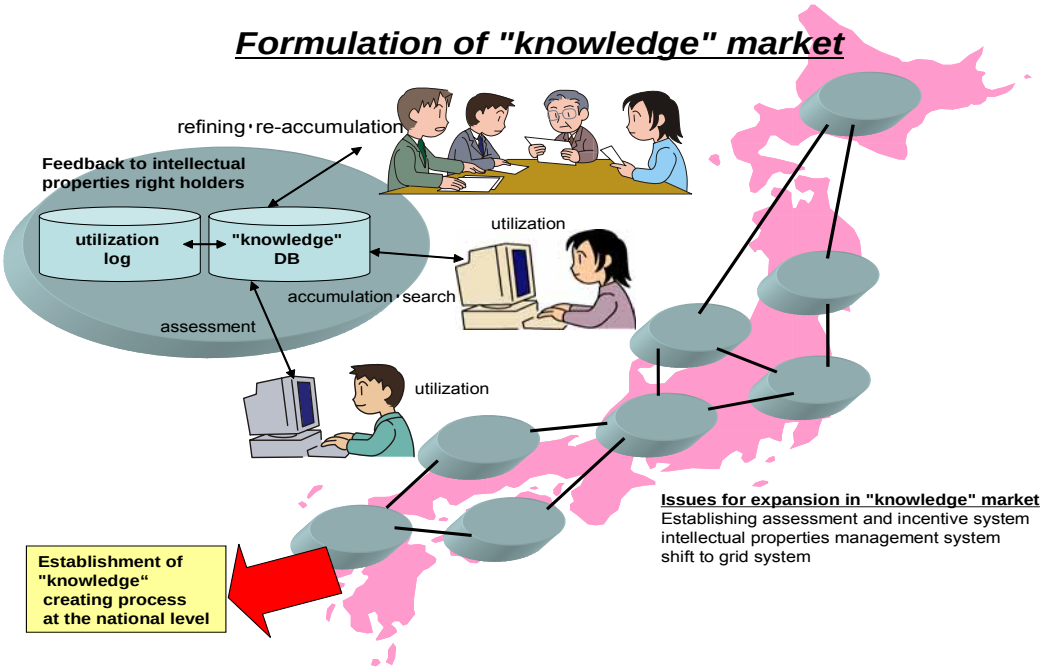

Figure 4-13　Expansion of “Knowledge market

4.2.2　Positioning of e-Learning system

Up to date, “e-Learning” has been used as a general term of the utilization method of information communication technology in education, training and learning. By defining the “Knowledge system in the previous paragraph, it is necessary to clarify the positioning of “e-Learning”.

The scope of e-Learning system was tendency to widely catch due to relationship of other application system and foundation system. However, like as the “Knowledge” system, education, training and learning that catch the “Knowledge from high viewpoint, is only partial information transmission or information acquisition technique, and application of the information technology is not self objective orientation. That is to say, from the viewpoint of why utilization of information technology to education training and learning is required, it is necessary to arrange the feature that can be clarified in the information acquisition technique or information transmission other than education training and learning. For the e-Learning viewed from the above point, it can be summarized as follows:

・Delivery of knowledge
・Accumulation of knowledge
・Retrieval of knowledge
・Skill transfer

(1) Development of Learning Architecture model

In the wide meaning, the Leaning Architecture also includes Performance Architecture, and there is model that training, learning and support are positioned as the element. Furthermore, assembly education, e-Learning and knowledge management are integrated into that, and are organically cooperated. It does not largely differ from the framework of the “Knowledge” system.

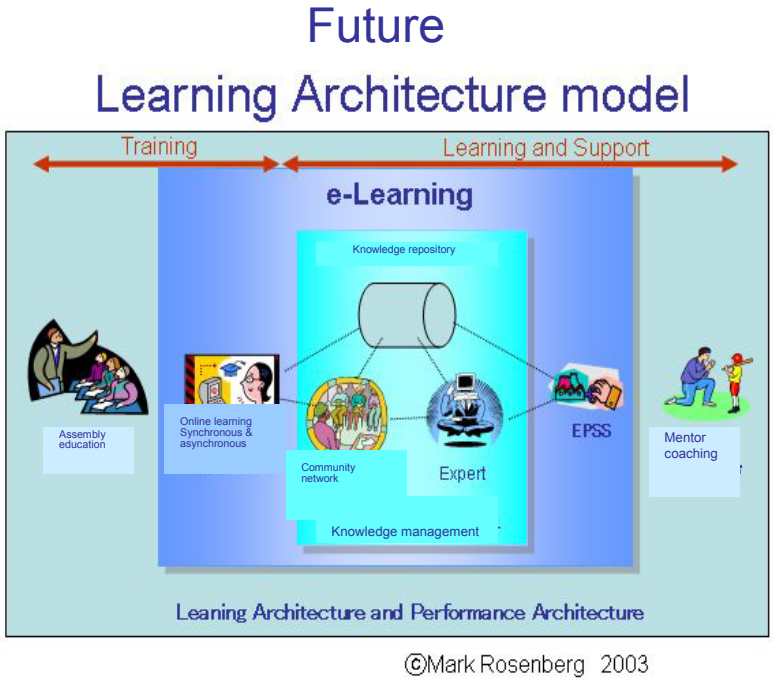

Figure 4-14　Learning architecture model

The feature of these education methods can be shown with the following figure.

	Training	Knowledge Management	Performance Support
Purpose	Instruct	Inform	Guide Performance Directly
Stop Work?	Requires Interruption of Work	Less Work Interruption than Training	Integrated Into Work Tasks
View of Learning	Program Dictates How Learning will Take Place	User Determines How Learning will Take Place	Learning is a By-product of Performance
Goal	Transfer Skill and Knowledge	Resource for User; Catalyst for Organizational Learning	Assist Performance or Do It Completely

Figure 4-15　Comparison of human resource upbringing system

(2) Learning Architecture model based on EA

In compliance with general EA (Enterprise Architecture), the learning architecture has been defined with the following 4 layers, and these arrangement make areas for technology and software development clarified as well as independence between hierarchies is improved.

① Management strategy and learning target
②.Knowledge and LMS, LCMS, SCORM, etc
③ Knowledge and LMS, LCMS, SCORM, etc
④ Learning foundation and network (security)

Learning model and courseware

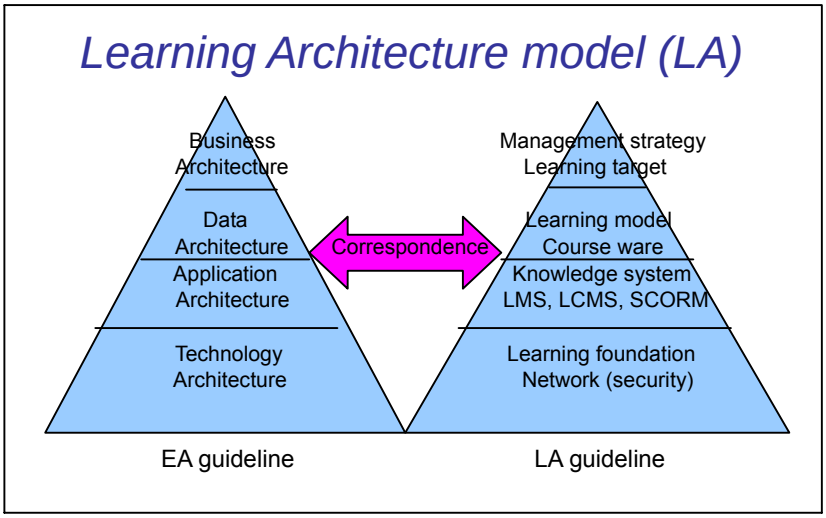

Figure 4-16 Learning architecture model

From this figure, knowledge system, LMS, LCMS, etc. are positioned at the application layer. Other name of this part is sometimes called service component architecture, and it is necessary to proceed the definition and standardization of service component to be supplied at this hierarchy.

(3) e-Learning architecture model

In the Department of Defense in USA, the following model has been introducing for the e-Learning architecture.

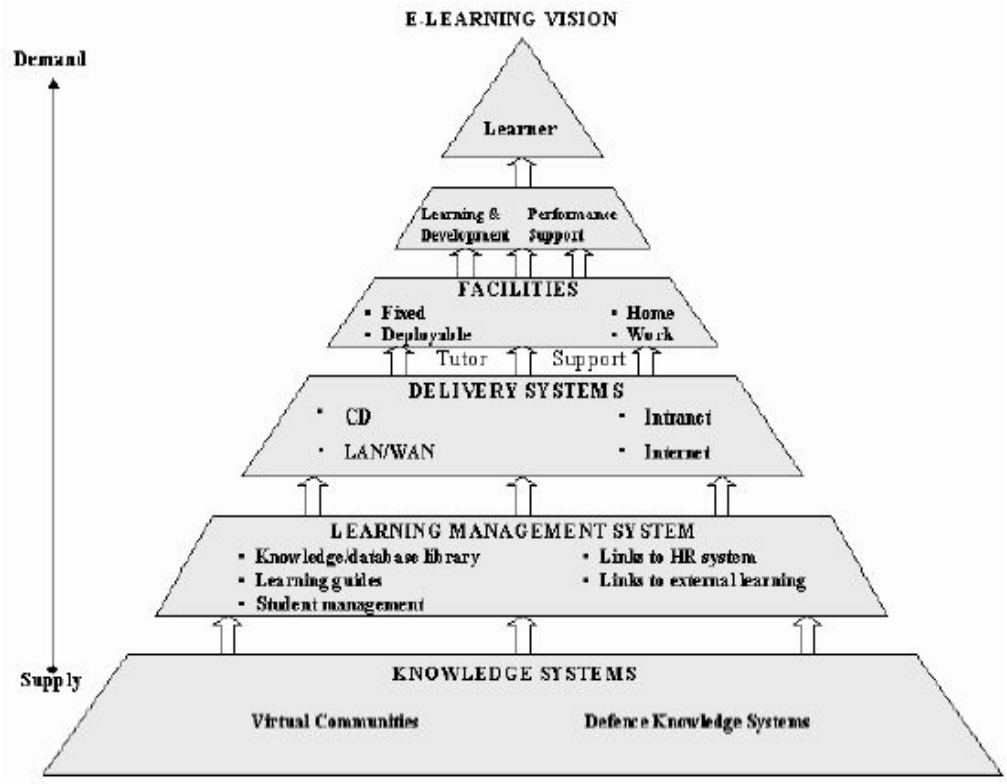

Figure 4-17 Example of e-Learning architecture

This is also similar construction to the e-Learning architecture based upon the EA, however the hierarchy expression differs due to that the condition to finally realize is stated. While, the constitution element is nearly the same element.

4.2.3 Relationship to e-Framework

(1) What is e-Framework?

The e-Framework is the project that was developed by a partnership of the Joint Information Systems Committee (JISC) in Britain and the Department of Education, Science and Training (DEST) in Australia, and is the framework of investigation study regarding utilization of the information technology for future e-Learning.

The framework prepares and defines support, reference model and standard service to service orientation approach in education training, investigation study and training management.

As the result, in order to determine the strategy to investigation study and investment for utilization of the information communication technology to each country education training connected to not only Britain and Australia but also international partner, the framework is to be supplied. The technical approach is based upon the SOA(Service-Oriented Architecture) highlighted with the information system by current web approach.

The e-framework, as shown in the following figure, has arranged user needs and contents mainly constituted the reference model, domain, common service, etc.

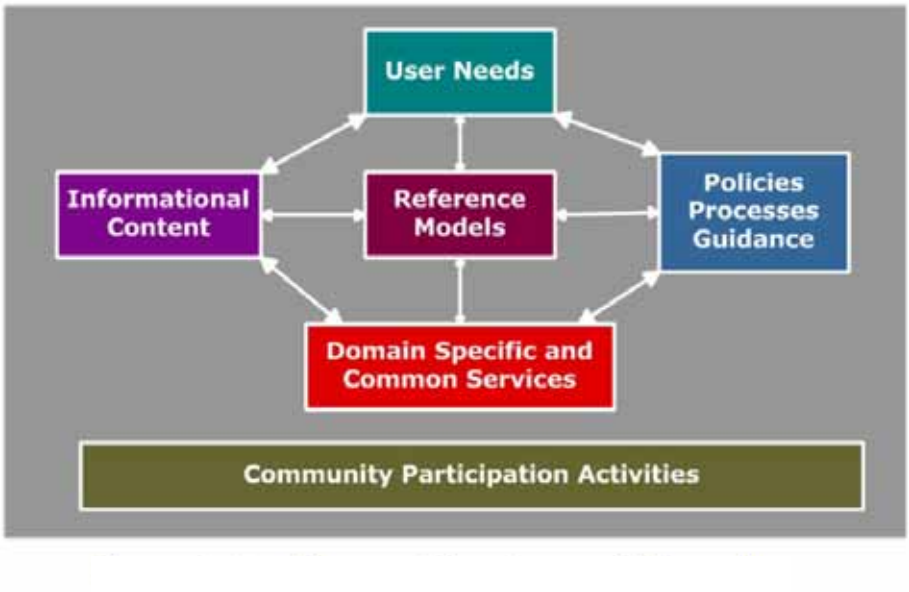

Figure 4-18 e-Framework (1)

(2) Service classification in e-Framework

The service classification consists of individualized service and common service. There are “e-Learning”, “e-Research”, “Administration”, etc. in the individual

service, and are resource, security, collaboration, etc. in common service.

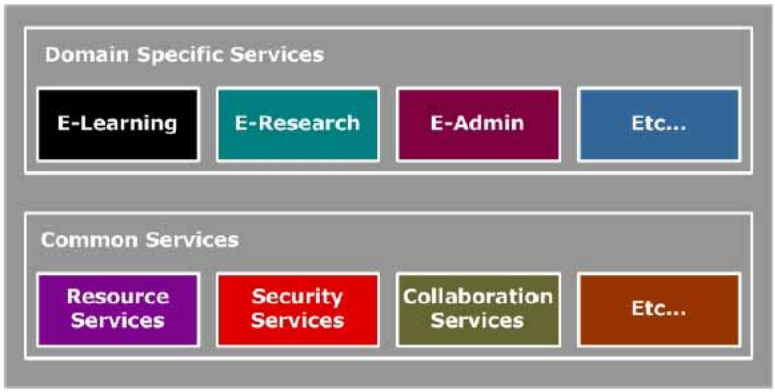

Figure 4-19 e-Framework (2)

The details are as follows, and can be referred as the service component classification in the Framework.

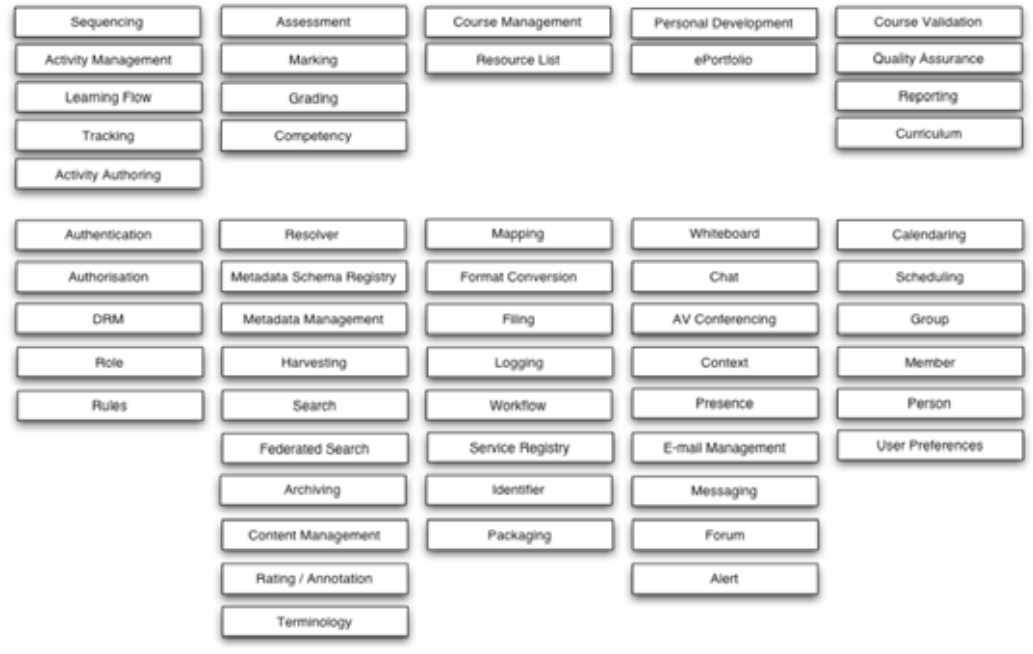

Figure 4-20 Details of e-Framework

The layout that services related to e-Learning is classified is Figure 4-20, and it is an important when the service component is maintained in future. In the actual utilization, the environment that required learning can be implemented, can be supplied using service models combined these.

Furthermore, Figure 4-21 shows of whether standardization and specification of these service tasks have been maintained.

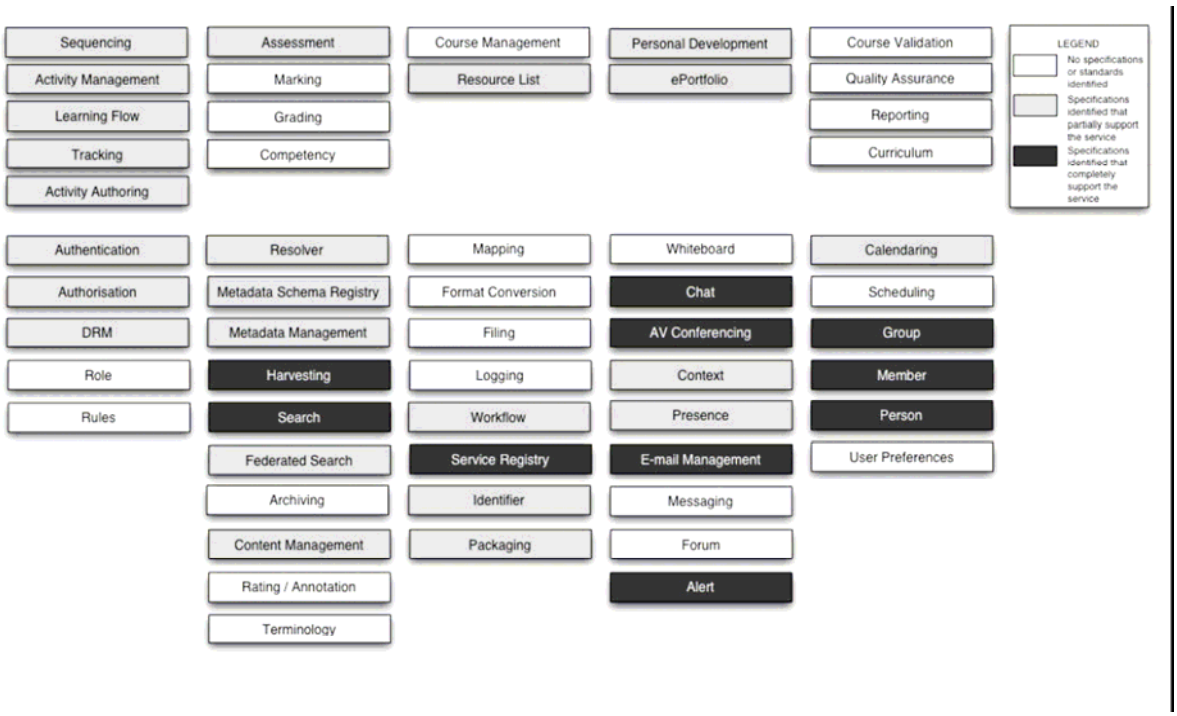

Figure 4-21 Maintenance status of service task

When concrete program has been supplied so that education, training and learning can be realized based upon the service component, and the learning mechanism becomes possible to more easily realize. In the “Knowledge” system, it is necessary to define these service components.

(3) Application of service oriented architecture

At the same time of e-Framework suggestion, a draft in order to apply service oriented architecture to the e-Learning system has been proposed as architecture to become the base. Various information communication technologies and their standardization that web service is premise, have been planned as technical foundation of these architecture, concrete model image is as shown in Figure 4-22. In this figure, the function is defined, abstracted model to these data and operation is architected. Data model and interface are defined as service component as service component in order to concretely systemize these, and definition of the web service is finally to define.

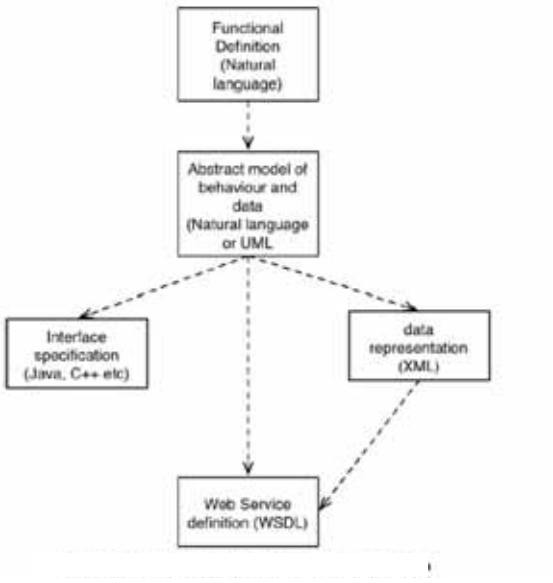

Figure 4-22 Various technologies and services

4.2.4 Toward realization of “Knowledge system

4.2.4.1 Required information technology for realization of “Knowledge” system

Figure 4-23 is the technical map that the e-Learning way was viewed from its technical series (recent IT technology), and wider range of technical relation that the “Knowledge” system exceeded e-Learning from this figure, can be arranged. These technologies are mainly classified into ①service component technology, ②content component technology and ③network component.

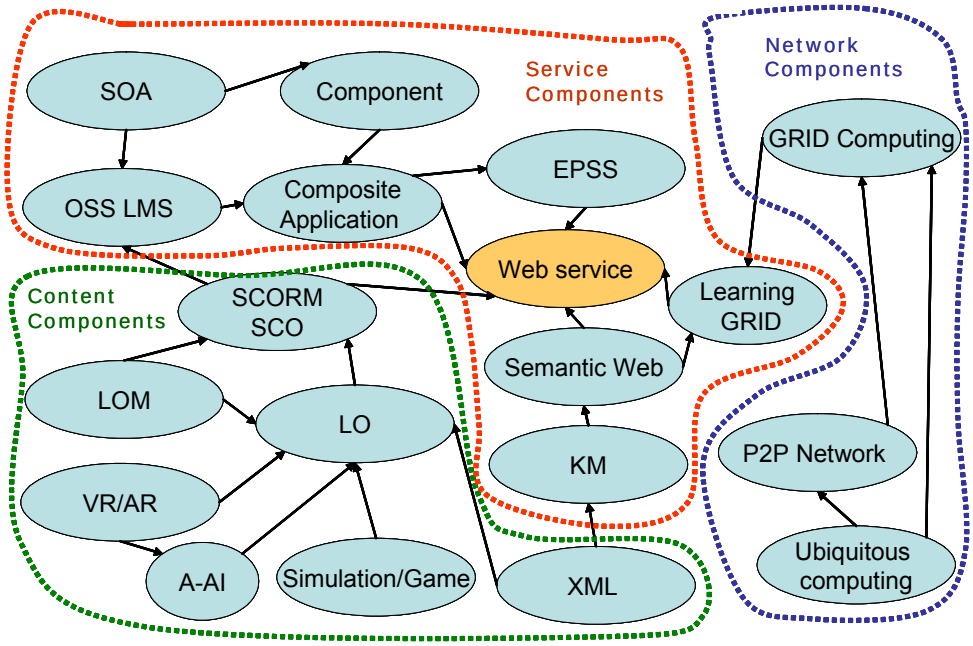

Figure 2-23 Information technology regarding “Knowledge”

SOA: Service Oriented Architecture
OSS: Open Source Software
LMS: Learning Management System
LOM: Learning Object Metadata
SCO: Shareable Content Object
LO : Learning Object
EPSS: Electronic Performance Support System
KM :Knowledge Management
P2P :Peer to Peer
VR/AR: Virtual Reality, Argument Virtual Reality
A-AI :Argument Artificial Intelligence

① Service component technology

There are a link of technologies including the standard for realization of the service component observed in SOA. Finally, there is web service as installation technology of the standardization by past SCORM, etc., and it is an important to be able to easily support the learning on the web. Furthermore, as larger technical foundation, the technology like as Learning Grid has been appeared, and the R & D for the realization is described in other paragraph.

② Content component technology

The definition of Learning Object (LO) as technology required for content creation and management, SCO on extended line and LOM as metadata for distribution and reuse, have been standardized. Furthermore, new technology to create LO is also important.

③ Network component technology

In order to make the learning possible to implement on internet, especially web, various technologies regarding new network technology is required.

4.2.4.2 Combination of element technology

Concerning the function that “Knowledge system should have, the element technologies related are as follows:

Table 4-2 Element technology

Function	Relate element technology
①Management system of “Knowledge ”	KM, EPSS, SOA,
②Collaboration system	EPSS, EAI, SOA,
③High information retrieval system	LOM, Semantic WEB,
④Learning system	LMS, OSS-LMS, SCORM, HRM,
⑤Content management system	LCMS, LOM, SCORM,
⑥Knowledge center	KM, EPSS, DWH

4.2.4.3 Professional image required for realization

The requirement in architecture, management and reuse of the “Knowledge system is to arrange from the human resource. For the professionals for education training and for e-Learning, various arrangements have been performed from the human resource.

However, there are actually many cases that speedy development cannot be realized to plan new development due to insufficient human resource. Therefore, before new “Knowledge” system is proposed, it is necessary to mention of how it does clarify.

(1) Professionals relating to “Knowledge system and e-Learning

Professionals relating to e-Learning are defined as follows:

Table 4-3 Professionals involving in e-Learning content development

Professional name	Area	Process concerned	Role
Content writer	Content	Documentation	• To document by obtaining information from professionals
Instructional designer	Content	Materialization	• To design content based on documented information
Content developer	Content	Media orientation	• To orient media based on content design
Content scripter	Content	Media orientation	• Programming, etc. of tool and object required for content production
Production artist	Content	Media orientation	• To produce special medias such as video, audio, etc.
Content engineer	Content	Media orientation	• Selection, etc. of IT technology used for content
Subject master expert (SME)	Content	Documentation/ materialization	• To create and compile description as professionals regarding professional field subject to content
Knowledge engineer	Content	Entire	• Application architecture to knowledge processing or knowledge accumulation
Web artist	System	Entire	• Selection regarding web technology and design of architecture
IT architect	System	Entire	• Selection of IT technology and design of architecture
Web designer	System	Entire	• Web design
AI expert	System	Entire	• Installation of artificial intelligent technology
Product manager	Content	Entire	• To control entire processes
Quality coordinator	Content	Entire	• To perform quality control regarding development

In reality, examples that many functions to be performed by many professionals are performed only 1 or 2 professional, has been frequently observed.

It is necessary to be able to develop optimum contents by SME as professionals of filed concerned, by instructional designer as professionals of course and content design and by professionals whose their intention is realized using optimum media as well as by combining skills of each professional field.

Furthermore, in content evaluation, it is necessary to note not only that diversified medias have been utilized and interactively designed but also that optimum learning model in order to learn using this content have been designed. It is also necessary to evaluate that optimum learning volume has been maintained in order to achieve the learning target, that intended learning model has been designed and the content matched with it has been realized, and that development process has been managed.

Furthermore, various professionals have been involved in the e-Learning content development, however the human resources defined in advance by ADL SCORM

2004 that is international standard, are as follows:

- Author
- Publisher
- Unknown
- Initiator
- Terminator
- Validator
- Editor
- Graphical designer
- Technical implementer
- Content provider
- Technical validator
- Educational validator
- Script writer
- Instructional designer
- Subject matter expert

4.2.5 Outcomes target as achievement index

In order to aim at utilization the “Knowledge” system, it is necessary to study the following achievement index as the outcomes target.

Table 4-4 Achievement index of “Knowledge” system

Outcomes target	Achievement index	Target date
1. To clarify system requirement of “Knowledge” system	To provide requirement definition document	2006-2007
2. To clarify system requirement of Japanese version learning grid	To provide Japanese learning grid requirement document	2007-2008
3. To search realization policy of “Knowledge” system in Japan toward	To organize search consortium of “Knowledge” system in 2010, and to search strategy document	2008-2009

4.3 Necessity and issue of Learning GRID foundation architecture

4.3.1 Preface

The e-Learning system means the information system that organic relation construction of various information resources that support individual learning, group learning, all round learning, etc. used internet environment. Furthermore, in the utilization style, synchronous and asynchronous harmony styles exist. Concretely, this is compound information system that technical matters that are learning material (content), asymmetrical DBMS (LMS), communication and media are interrelated.

As the next generation e-Learning system, the e-Learning system of knowledge architectural type that intellectual-sensible-social interaction (in human Vs human, human Vs system and human Vs society) was taken serious view, are requested. Especially, harmony learning and work environment with high function are architected, and the systems that have screen co-ownership, operation co-ownership, learning activity log co-ownership and knowledge co-ownership and reuse with general purpose frame (intellectual black board), are requested by realization of plug-in function of collaborative tool. These are also technically search of collaborative agent technology. Furthermore, it will be necessary to educate the knowledge architectural force from evocation, analysis and evaluation activity by visibility of individual learning activity and group learning activity.

There, matters of growing type learning environment from special social interaction and knowledge distribution, social computing, communication infrastructure, synchronous and asynchronous material constitution theory and constitution principal of content for harmony learning, become issues. The following social foundations are requested: knowledge of not only individual but also organization is to acquire, crate and add value, use jointly, reuse and grow as organization.

In the production process of knowledge under e-Learning Society, learning and search with high freedom have been requested, the necessity of environment that effective learning place and application shall be deepened, is taken serious view. Furthermore, in the consumption (utilization) process of knowledge, the foundation that supplies to society is requested by the frame that has integral connection to non-continuous knowledge diversified into individual and organization. For that, it is necessary to devise the mechanism related to non-continuous, asymmetrical and diversified knowledge base. It therefore needs the Learning GRID concept.

4.3.2 What is Learning GRID?

In high knowledge society, life cycle and change cycle that are knowledge base, are extremely and rapidly progressing. The social and technical foundation that acquires knowledge by both individual and organization, creates, adds value, uses jointly, and reuses, becomes important. It becomes mandatory that research of which production, distribution and consumption cycle of the knowledge are handled, constitutes education and learning organization that has circulated construction of the knowledge to keep teachers and learners continued in the Learning Society being realized. It is considered that workers in society always learn and needs of creation activity of knowledge are increasingly expanding. The activity of both individual and organization is the same.

Learning individual, learning organization and learning community constitute the Learning Society of genuine meaning , that is to say, successful society. Here, communication and collaboration to transmit information from individual to organization and from community to society, play an important role. Nowadays, style and quality of communication and collaboration are remarkably changing by the information communication technology. Everyone can easily perform from anywhere of that diversified information is used jointly, accumulated, re-architected and reused. However, the effective way for creation and cross-transmission requested and the learning environment that becomes axis of the knowledge circulation, have not been theoretically and technically searched.

In web base learning and e-Learning as technique of learning and job training in not only school education but lifework, the learning environment (Ecology) and Pedagogy which differ from conventional learning activity in quality, have been spontaneously starting to rise. Presently, concerning these issues not maintained, in order to guarantee steady learning activity of learners which are users, maintenance with proper direction is urgently needed.

Here describes concept and constitution of the Learning Grid as next generation learning environment for knowledge creation and circulation. Furthermore, the concept and description of the Pedagogy in new learning environment and style, that is to say, the e-Pedagogy are also described. The following shows arrangement of the Learning Grid concept, Learning Ecology that is learning environment there and e-Pedagogy that supports the learning action:

4.3.2.1 Definition of Learning Grid

The Learning Grid is a general term of the education service in the high information knowledge society and of the information foundation for realizing it. The Pedagogy that integrally handles the life cycle of research, development regarding the Learning Grid, knowledge acquisition, discovery, architecture, transmission, co-ownership, reuse and knowledge of high value through experiences, is the e-Pedagogy. The learning environment supplied by the Learning Grid, that is to say, the Learning Ecology is the learning environment that conventional school room or learning place on web and e-Learning are included and that can accurately correspond to flexible and learner’s diversified needs.

Due to opportunities of learning chance extension and learning environment expansion, the program that the e-Pedagogy is systemized, is starting to develop worldwide. This tidal current has started in Britain who tackled with the Learning Grid as nation in 1997. Thereafter, especially, pioneer research in EU and Japan has been showing germination. These programs differ from the point focused to the maintenance of information foundation, and is the description that fulfillment of services such as human resource upbringing, that is to say, school education, lifework learning and job training were conscious at national scale. At the same time, it is worthwhile to note that it has been positioned as policy with technical guarantee of realization method when establishing the Learning Society.

4.3.2.2 Meaning as information technology

The technical requirement of Learning Grid is architected based upon open dispersion service model. The information foundation that architected the Learning Grid in EU, has been designed for the e-Science, and application development for super computer at the environment had been performed. By developing the outcomes, the maintenance for Gird Computing as the information foundation for

scientific investigation that was conscious of cooperation between various professional areas, has been progressing.

In the Grid foundation, by cooperating with the Gird Central Center and related organization server, computer resources in each local area, application, storage, etc. can be distributed and jointly owned. That is to say, users can access to CPU, storage and application through internet. The Grid Computing technology is supplied to users by such method that is safe and always possible to use. Here, the Automatic Computing has been concreted, and the e-utility dynamic provisioning services on Grid foundation is realized. In these information foundation, the framework (the Open Grid Services Architecture) that consists of Grid foundation and web service has been applied. This framework efficiently realizes co-ownership of various resources that are dispersed and managed.

By developing the OGSA to technology for learning, e.g. the Learning Grid, the open Grid foundation and service for learning, education and training are easily realized. That is to say, by the Learning Grid, realization of the Learning Society that is the Paradigm in the Pedagogy, becomes possible. Like as the information technical foundation shifted from internet to web and the learning style and place shifted from CAI/ITS to e-Learning, the foundation will shift from web to Grid, and the learning place will also shift e-Learning to Learning Grid.

4.3.2.3 Concept of National Grid for Learning in Britain

The Learning Grid policy (NGfL: National Grid for Learning) in Britain has started in1997. Outcomes, etc. of program of the high information network utilization in the British Education Institute that is leading research that was started since 1995 have been extended, and have been shown as the government policy. The Learning Grid in this policy is defined as “Integration education services at school, library, workplace and home where supports teaching, learning, training and school management”. The integration of network foundation and services of education, learning and training is shown as the national policy regarding new technology utilization such as ICT (Information Communication Technology), and improvement of people life and international competitive power (especially, basic literacy of reading, writing and calculation) have been awakened.

Moreover, the NGfL activity that is presently displayed on official HP has become development that is specialized in ICT ability development for only learners at school and teachers.

4.3.2.4 Learning Ecology in NGfL

The NGfL is not program being subject to only children student belonged to the education institutes. It is services for all people including workers, non-workers, retired persons, etc. The learning opportunity to all people is supplied, and maintenance of learning opportunity to all people is to guarantee. All public facilities, all education, learning and training service place suppliers, e.g., from kindergarten to university, library, adult school, museum, gallery, etc., becomes the learning places for the Learning Society development. For that, the technical foundation that all related organizations are integrated through network, is maintained, and these

connections between organizations are extended to homes, workshops, and public facilities.

The Learning Grid in NGfL supplies the framework for inter-connected network and service aggregates. The subject of Learning Grid was to teach education/training and school education. Then the subject is developing to home learning, higher education to be continually performed and lifelong learning including job training. The Learning Grid closely relates to ICT program supported to public institutes and maintenance program of education institutes for job training. National and public museum, art gallery and institute that supply various type of content, play an important role for the Learning Grid. Library that has many information and is familiar existence for general people, can be mandatory element. By integrating these organizations, the NGfL can be used by all learners to read world intellectual, culture and scientific resources. The information can be virtually and freely dispered and managed on internet. The Learning Grid is also applied to not only public education but also private learning. Here, in order to guarantee that justifiable profits of content creator and publisher are protected, the protection of copyright and intellectual property is kept an eye on, and it is necessary to take action to be consistent with supply without utilization limit. The development of right protection technology in the Learning Grid has been vigorously performed.

4.3.2.5 e-Pedagogy in FGfL

When realizing the NGfL that is the learning network at national scale, the first key is to be the skill development. That is to say, it is said that human resource upbringing that plays role to guide education, learning and training in the Learning Grid, is urgently needed. When performing these human resource upbringing, the upbringing of ability regarding information technology and learning technology (Quality in Information and Learning Technologies) is especially conscious. In order to guide education, learning and training in the Learning Grid, It is therefore required of not only learning conventional pedagogy, network environment, environment that the diversified resources can be seamlessly accessed, pedagogy at environment where learners who embrace the diversified needs, e.g. recognition and understanding regarding the e-Pedagogy and experiences. The debate regarding the e-Pedagogy in the NGfL, has been performed in the expert group regarding “e-Learning and Pedagogy” in the Learning and Teaching Committee in the Joint Information Systems Committee (JISC). Up to date, the investigations regarding e-Learning Models study, Effective Resources study, Learning Design Tools and Practice Case Studies have been performed. Of these, in the e-Learning Models study, existing learning theory regarding the e-Learning, framework and model have been reviewed. These 2 points are summarized as follows:

① To make Mapping with experiences and model easy, and let them promote understanding regarding more effective experiences, and

② To clarify the describable scope of present model when the Learning Ecology is designed and installed.

The review was performed based upon 3 viewpoints (Associative, Cognitive and Situative) in the learning theory. The results are shown in Figure 4-24.

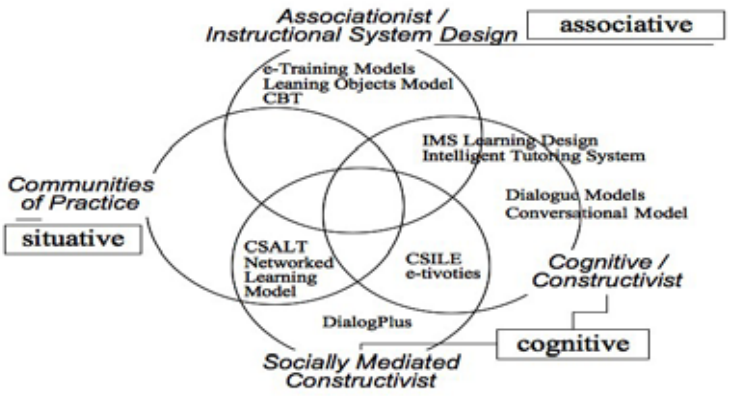

Figure 4-24 Learning theory for knowledge architecture

Assotiative (Action Principal, Union Principal and Instructional System Design by experimental methodology): Learning theory group was focused to learning description. The model examples are e-training (learning that performs training at e-Learning style), CBT (Computer Based Training), Learning Objects Models, etc.

Cognitive_1 (Recognition principal and constitution principal): Learning theory group focused to private task, formational evaluation and interaction. The model examples are Dialogue Models, IMS Learning Design, Conversational Framework, etc.

Cognitive_2 (Social constitution principal): Learning theory group focused to group task and debate. The model examples are CSILE, e-tivities, DialogPlus, etc.

Situative (Situation theory) : Learning theory group focused to Community of Practic architecture. The model examples are the CSALT Networked Learning Model, etc.

The e-Pedagogy foundation is forming in future based on thes outcomes.

4.3.2.6 Learning Grid in EU

(1) Overview of ELeGI project

In EU, the European Learning Grid Infrastructure (ELeGHI) that is original research project of the Information Society Technologies (IST) is leadership regarding the Learning Grid research.

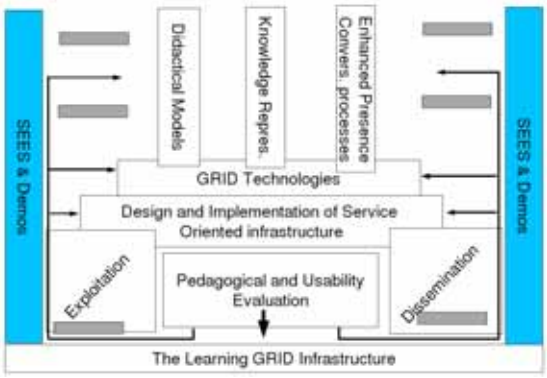

Figure 4-25 Activity overview of ELeGI

3 final targets of Learning Grid establishment in EU are as follows:

Goal 1. In order to define new learning model that is possible to collaboratively learn by the Ubiquitous, approach based on experience principal, approach for individualization (compatible) and approach complied with context matched with status, are integrated.

Goal 2. Software architecture based on higher grid technology is defined and installed with the service orientation as learning and work environment.

Goal 3. Software architecture of the Learning grid and pedagogy approach are validated and evaluated through technical validation as installed test bed (SEES: Service Elicitation and Exploitation Scenarios) and SEES trial.

The outcomes of Goal 1 are integrated as e-Pedagogy. By the outcomes of Goal 2, integration of various technologies and resources required to realize new learning Paradigm and access to content are realized. This target is designed based on factor specified by educational needs and SEES, and the specification is to be concreted through installation process. That is to say, the foundation of Learning Grid is to be formed. Learning And by Goal 3, the utilization and effect of the Learning Grid are to be verified.

(2) ELeGI activity

The International Workshop regarding the Learning Grid has been held by the Learning Grid of Excellence Working Group (LeGE) ELeGI in the ELeGI. The ELeGI activity, e.g. tackling with the Learning Grid in EU has been described in third LeGE Workshop in details. The project objective is to design, install and verify the service oriented and pedagogy-driven software architecture based upon the Grid Computing technology in order to support learning (refer to Figure 4-25). The knowledge architecture in this activity shall be formed by the following 2 learning.

① Concept understanding based on experience:

Concept understanding through direct experience (for example, supply of access to actual world data at extremely actual context for learners, etc.). This experience is supplied by high software interface, device and service.

② Social learning:

Collaboration performed among other learners, teacher, tutor, professionals, or human learners related to peer. These various types of collaboration are used for learning.

The Learning Grid must support such learning activity.

(3) Key concept in ELeGI

In order to have these learning activities meaningful, the key concepts of ubiquitous, collaborative, experiential, personalized, contexualised are materialized, and supply it suitably and effectively to the learners.

The Ubiquitous promotes learning uniformity of learning opportunity of learners, and guarantees unevenness and accessibility of learners. In order to realize this, wider range and flexible access technique which the learning of “anytime and anywhere” becomes possible, is requested. Not only services but also development effort of hardware are required. That is to say, the diversified types of device,

interface and network connection are required to be supported.

The collaboration is the learning action supported by the social constitution principal. The group activity must be supported by the natural manner, like as the same that performed to individual learners in the past. The collaboration mentioned here also includes support to self organizational online community that has common educational goal.

The experience principal is the methodology supported by active learning theory. The release for learning must indicate the reaction to interactive, attractive activities and the activity form learners. In the active learning and the knowledge formation followed that, existence of outcomes more than simple information transmission is emphasized. Furthermore, the learning closely cooperated with actual world is also the learning style supported by the experimental principal. In the case actual world data (stock market price and remote detection data, etc. changed with real time) is utilized, the services (virtual reality space, etc. of simulation, simulation interactive animation and immersion type) that have applicable interface to utilization environment of learners that are high precision and high accuracy, are mandatory. Furthermore, the technical foundation that has parallel processing control that can support the learning activity at group and has high calculation capability that can accurately perform co-ownership of learning resource, is requested.

In order to guarantee the learning privatized, it is necessary to let them have the feeling that in accordance with own learning request, own personnel stays at the center of online learning environment. The learning experience of learners should be always confirmed whether it is reasonable to own learning objective, and the quality of learning description should be evaluated.

Guaranteeing the learning by context along with the status, is to realize the learning suitable to the learners. The context of learning suitable to learners is gradually changing with progress of the learning. This is the same not only online learning but also in the traditional static status of classroom and library. The Learning Grid requests the dynamic creation of the learning context. Realizing the contextual is to change conventional aspect (for example, existence period of teaching module, etc.) to the online learning environment. The online learning supplies unchangeable and stable services. That is to say, it is aspect to be the subject that same reaction always indicates. That is to say, the contextual, in order to realize the applicability to the learners, it is necessary to frequently update and change (for example, several times a day) the module for teaching. The renovation of online learning environment is mandatory. Such dynamic behavior has not been equipped with many existing e-Learning services.

4.3.3 Subject of knowledge in Learning GRID

The subject of knowledge in Leaning GRID is a whole knowledge that generates in the various activities that become service subject in this world. Firstly, the knowledge problem is to consider.

4.3.3.1 Creation, distribution and utilization of knowledge

The question of “What is knowledge“ is difficult to clearly answer. If it scientific expression, things being performed in human inside, e.g. there are knowledge as techniques to operate things such as recognition, thinking, reasoning, memory, concept formation, language, image, problem solution, creation, etc. The knowledge has deep relation to language. The language connects to substance of things, and the substance has behavior. That also links to perceptional function of image. The concept has action that the substance abstracts, and strongly relates to formation of thinking power.

In the filed of knowledge science, the knowledge has been debated with the classification of “Declaring knowledge”, “Proceeding knowledge” and “experimental knowledge”. In another words, it could be said to be the problem solution knowledge (discernment knowledge) based on the material knowledge and experiment. Recently, it has been called as “Form knowledge” and “Tacit knowledge”. Anyway, as to 5W１H model knowledge, elucidation and accumulation of the knowledge（knowledge if α then β）regarding application under various aspects will be required.

Here, it is reviewed from organization management being subject to the e-Learning.

① Knowledge creation

Recently, in industry field, concept and technology of the knowledge management have been advocated. The knowledge mentioned here means the form knowledge and the tacit knowledge, however the form knowledge is material knowledge, while the tacit knowledge is know-how. The know-how is the knowledge with condition (limitation) obtained from experience and practice. The creation ability of this knowledge has been requesting. Especially, in industrial field, this ability has been requested from trade-off relation of investment and profit, this type of knowledge that generates with various works and places has been organizationally managed, and concept of knowledge management with meaning of co-ownership and reuse has been conscious. Furthermore, Thing of how the tacit knowledge should convert to the form knowledge is not only inner operation of private level but may concepts and the methods that make it actualized from actual action of social context and problem solution, have been suggested. Recently, various collaborative tools and group ware that utilization at internet environment were assumed, have been developed from the classical methods of K－J method and brain storming. Furthermore, the knowledge engineering technology that supports the knowledge creation has been also searched. For instance, the text processing technology is the technology that summary processing and important sentence to various natural language sentences are extracted. Generally, the summery processing is performed by knowledge bases such as story sentence and interactive construction grammar as information that extraction of important terminology and terminology correlativity based on morphologic analysis and appearance frequency are handled. Furthermore, the data mining technology is the technology that useful knowledge is dug up. It means that it becomes the “Knowledge Discovery in Database: KDD”. That is to say, the knowledge means relation between data elements and its pattern, and the knowledge extracted must be new and useful information in private and group from actual works and issue solution.

② Distribution of knowledge

However, since the knowledge in problem solution has meaning in social and

situational context and is extremely private matter, co-ownership and reuse of the knowledge are technically difficult. In another thing now, useful knowledge is important assets whatever private and organization, and the concept of co-ownership of it involves issues of copyright and intellectual property, and the co-ownership is difficult. Therefore, in order to smoothly perform the knowledge distribution, the organization logic to guarantee the profit of knowledge producer becomes mandatory. That is to say, it is necessary to review private and organization relation from viewpoint of management. Furthermore, there are technical difficulty to extract and acquire the professional knowledge and experimental rule that are expressed by various knowledge activities of human called the knowledge base. This is the problem of knowledge distribution.

③ Knowledge utilization

The knowledge management is, so to speak, organizational and technical activities that support the knowledge application. In various organizations, in order to improve works and to expand the profit, utilization of the intellectual assets is requested. The knowledge management is to jointly own them through information, knowledge, acquisition of know-how (wisdom), creation, editing, accumulation, management and utilization. The mechanism of support management is necessary to be dynamic and efficient. The aforementioned data mining becomes important function. Anyhow, the knowledge application is action of the knowledge (tacit knowledge) with the aforementioned condition (limitation). At that time, 2 points are considered. Point 1 is to consider similarity of the condition (is also similarity of application subject). Point 2 is to change by corresponding to application subject of description of the know-how. This is more daring conception, that is to say, this application with the condition ignored.

4.3.3.2 Co-ownership distribution of knowledge

The knowledge production and distribution model of (education) organization must be also searched. The knowledge learning as a legacy is performed by the e-Learning, and the activation of knowledge acquired is performed by the e-Collaboration. There, discovery and architecture of knowledge are assumed. The collaborative learning way can be arranged with result co-ownership and task co-ownership, however important thing is the role setting used the distributed cognition function. There, the media through the distributed cognition is important. We are calling it as “Collaborative memory”. In any learning style, these based on the learning become private asset as well as organization asset. These asset management and reuse largely depend on the organization management power. The organization to continue learning can be positioned by the frame. There, sustainable, competitive and advantage must be clearly indicated. Due to that, total evaluation function is mandatory. Further, among organization activity and learning cycle, positioning of the collaborative learning for accumulating and reusing the knowledge base cooperated, becomes extremely important. With recognition of such macro visual field, the organization management and system of distribution and growth must be designed. Figure 4-26 shows these relationships.

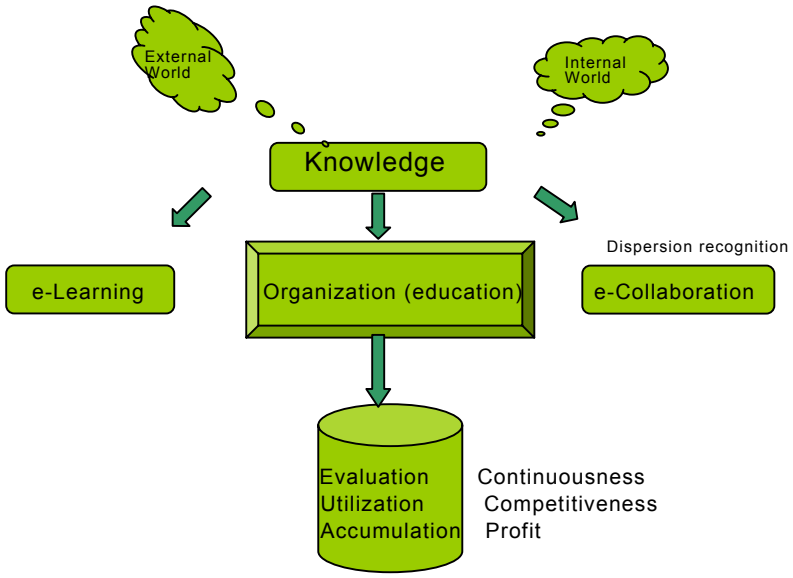

Figure 4-26 Knowledge managing in education

In recent year, things such as lecture support technology of web base, work and experiment environment of web base (virtual work and laboratory), multi-agent application, ID technology for online course ware, reusable learning object, quality assurance (content and education service), measurement, testing and evaluation, have been highly interested. These are also plan of quality knowledge distribution.

The writer calls such information aggregation is plural asymmetric data ware house, however the knowledge management mechanism for extraction of information related to management of this information group, includes the function of navigation and systemization that the content to be referred next by corresponding to needs and understanding level after the process to refer to the web content. Furthermore, like as group ware and collaborative learning, work and learning environment are virtually expressed and visualized (by avatar, etc.), and as if such environment, there is some co-ownership of actions that are synchronously and asynchronously devised. 3D interface and VR technology are applied to these, and the interface with reality has been devised. In such environment, the co-ownership of various data, information and knowledge can be devised. If the technologies such as related database and data mining are applied to their activity history data, the knowledge management system can be architected.

4.3.4 Education service scenario in Learning GRID

The e-Learning service cannot be helped to be the distributed collaborative system. And it can catch as the virtual learning organization of service orientation. That is to say, the Virtual Organization (VO) is the organization who each LearningGRID executes the object connected with network. The feature is to have heteorogeneity, dispersion and co-ownership. The VO uses thorough web service technology to develop, and consists of 4 constitution elements as follows:

① Users (service suppliers, service receivers….producers and consumers)

② Organization (physical status of service suppliers and receivers: as software

constitution elements)

③ Utility constitution elements (technical software constitution elements corresponding to objective)

④ Supplemental constitution elements (software constitution element that supports communication between VO and external thing)

The following users and organizations can be established by these premises in VO world.

4.3.4.1 Users and organizations

The users are characters relating to various services in VO.

- Learners
- Expert learners (learners who have professional knowledge and skill and play role teaching assistant: free of charge)
- Freelancer and tutors (professionals who have professional knowledge and skill: paid)
- Skilled searchers (managers who search and hire qualified staffs)

Further, characters who are knowledge managers and administrators are assumed.

In each activity body (agent) consisting of VO, the following organizations are assumed.

- Publishing house: PH (local repository is searched and retrieved by accumulation and distribution of learning content, metadata and query)
- Web catcher agency: WA (learning contents are directly extracted from Web or Semantic. Metadata is automatically extracted and knowledge mining function is also equipped with)
- Tutor agency: TG (to act as entry point for freelancer and tutor. Archive for freelancer tutor is managed, and human resource is searched and excavated)
- Broker office: BO (tasks such as environmental setting and agency searching corresponding to user request are performed)
- Training agency: TA (tutoring activity and course supply are prepared. Further, course management, execution function and learner model (management of learning history log) are conducted.)
- Knowledge agency: KA (knowledge construction (concept dictionary and ontology) is managed in whole network.)
- Café: CA (synchronous and asynchronous collaborative place is established, and social interaction, mentoring and information exchange are supported. Group constitution between users of TA registered corresponding to needs is adjusted.)
- Skilled agency: SA (required suitable professionals are searched depending on objective and request. It is searched from learner’s model database of TA registered.)
- Bank: BA (transaction processing of various log information generated in whole VO and various payment processing are conducted.)

Figure 4-27 shows the interrelation of these organizations. In VO, each

organization supplies the environment that process, resource and other organizations are used each other. The resource has the one belonged to the organization, however the collaborative co-ownership is conducted by objective and process of subject execution. Furthermore, it has container role for data and information co-ownership between organizations. The process also has the collaborative functions between organizations and between organization and inside resource. The process has mechanism that resource and other process are used each other.

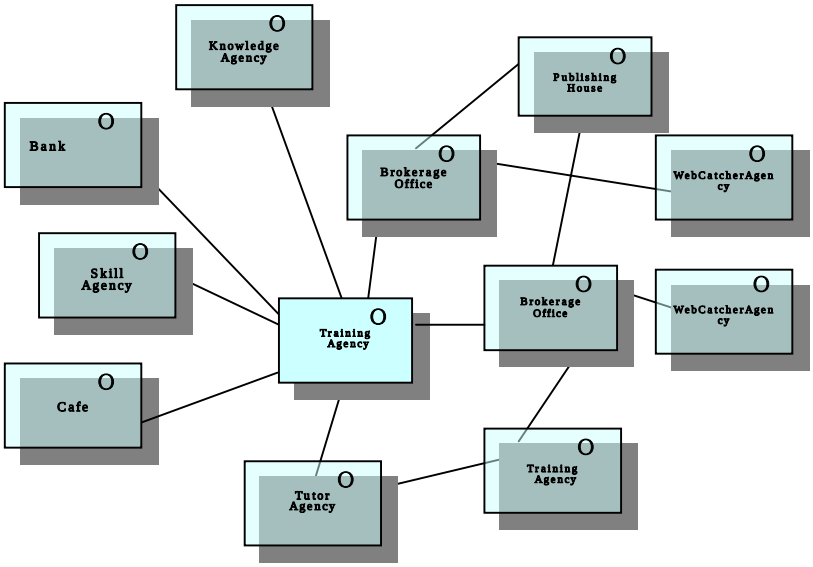

Figure 4-27　Relation of organization constituting VO

4.3.4.2　Constitution element of utility and accessor

In order to guarantee the technical completeness, VO includes the following 2 constitution elements.

Validation agency: In registration and validation of users in VO, all services are supplied. After validation is given, the token is handed over to user.

Service registry: When using, white page (information for service included), yellow page (service guide categorized) and green page (information regarding service execution method) are supplied.

The accessor constitution element permits access to VO service and access to external service. The internet entry point to all users is supplied, and the information regarding registration of users and organizations is supplied. Further, administrative processing information to service registry is also supplied.

4.3.4.3　Example of service scenario

In the next, examples of several service scenarios are shown.

① Service scenario example 1

Figure 4-28 shows the example of orchestra type scenario. Each block in the Figure is the aforementioned agency, and the arrow mark and the numerical number show the direction of information propagation and the activity respectively. The learner offers individual training request to TA through the entry

point (web portal of TA).
In order to constitute suitable learning path, TA transmits the concept request to be targeted to KA. Suitable learning path is consisted with all concepts required for that learners reach the target concept. KA constitutes the learning path by referring to knowledge construction, ontology, concept dictionary and knowledge that learners have acquired.
When the learning path is prepared and the learning strategy suitable for learners is set, TA calls BO. BO performs preparation of total training environmental setting based on the information acquired from TA (learning path, learning strategy, learner model, etc.).
BO calls PH and WA, and supply of usable material list matched with the required specification of TA. This list includes learning object and metadata described cost.

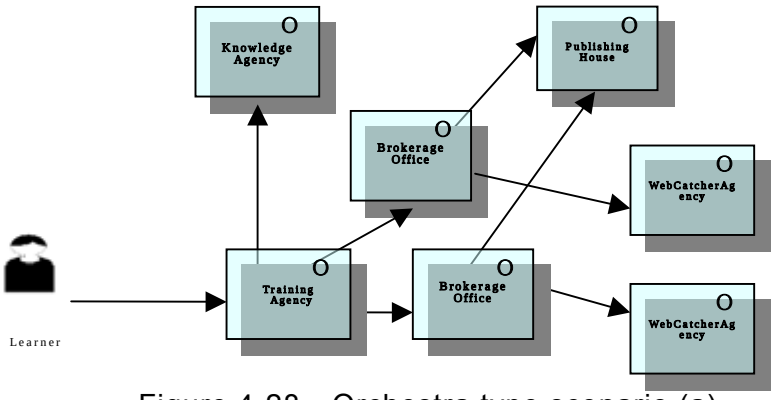

Figure 4-28　Orchestra type scenario (a)

② Service scenario example 2

This consists of 3 activities as shown in Figure 4-29.
The freelance tutor accesses to the job list via TG.
TG asks the request to TA, and requests the job to appropriate TA. TA supplies the tutoring environment. In the environment, the tutor can monitor learner’s activity, status, profile, result, progress.
TA can supply the entry point to CA that the tutor can meet learners and mates. And the environment that can communicate to them is set.

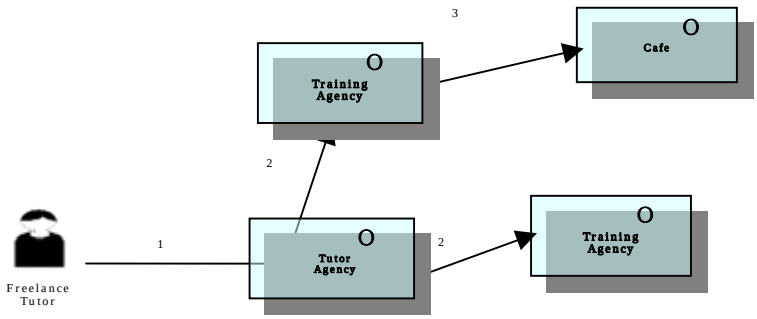

Figure 4-29　Orchestra type scenario (b)

model. At first, the freelance tutor activity is to consider. Here is the scenario that

supports the group learning. 2 steps (1 and 2) in the figure is the same as the aforementioned scenario.

In the next, the value added that has the grid technology constitutes group, the related mates are invited, requirement and skill are conscious, and it is necessary to supply the collaborative feature that can join the collaborative learning session. Therefore, 3 steps are required.

Paragraph 3 tutor is accessed to the café, and several objective concepts are supplied. In such collaborative environmental setting, in the case, for instance, high realistic and virtual scientific experiment and works are supplied, the VO role extremely becomes important. And that depends on the collaborative feature of the organization. The café prepares standard pedagogy model for such expression and experiment via interaction of other organization, and then defines. The learners belonged to the group reacts each other using the group accessor constitution element that has interaction with the café organization, and is accessed to the virtual experience.

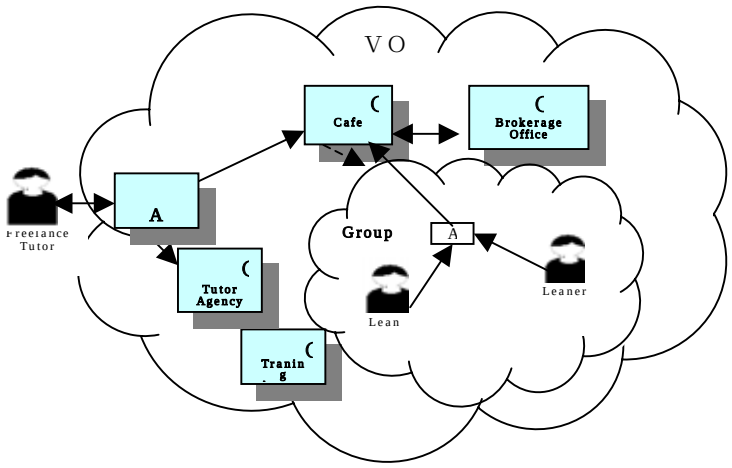

Figure 4-30 Collaborative learning enviror

In this model, the learners can plunge into learning with special context via suitable simulation. And they develop aggressive learning process by effective abstract level. As the result, they progress to knowledge constitution learning by the dynamic method. In this learning model, the learners accept other learner’s support (is collaborative feature), and actual learning can be expected to develop through comparison their concept and action. That is to say, it can be said that the knowledge plays medium role in the learning process.

4.3.4.4 Design of abstract organization

Each organization in VO can observe with the service provider. Therefore, VO is the aggregated body of joint service that supplies clear result to users through usable access point (web portal). Each organization plays unique role in internet, and supplies related service as web service. Further, each includes in the web server, and must guarantee the clearness from external via the web portal.

Figure 4-31 is the constitution element system of organization at the abstract level, and each organization included in VO has the foundation to be same core.

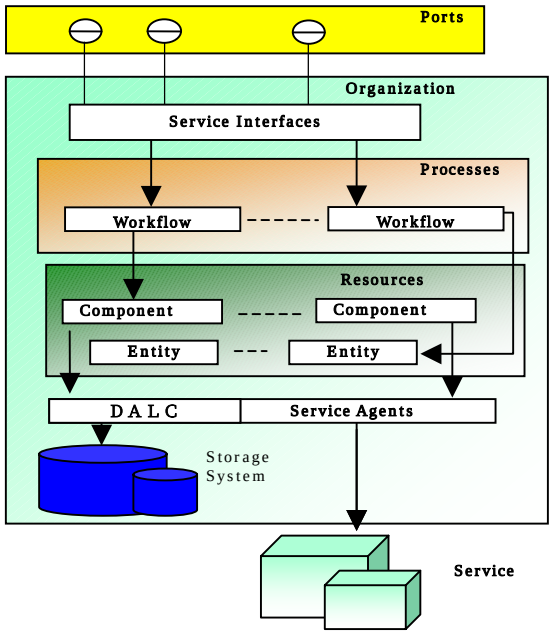

Figure 4-31 Constitution mechanism at VO abstract level

・Ports: is access point to particular service for a certain organization. Each service is requited to have been noticed. They are; a) “Notification source port” (interface display port for users who wish to receive particular service), b) “Notification sink port” (port to receive notice of service result required), and c) “Notification subscription port” (service port for subscriber to manage the subscription to particular service in the source service). Each port supplies general purpose scheme for pattern of notification and subscription.

・Service interfaces: supplies “Business theory” as service. This constitutes interface to support the communication contract proceedings (communication of message base, format, protocol, security, exception, etc.) that various consumers require. This is referred to as the business façade. Each organization uses this façade pattern in order to collect the information, and deals with the send request as shown in the second layer. The business façade object performs validation and authorization. The façade calls the workflow to execute the business. The façade pattern supplies uniformity interface to a link of interface in the subsystem. In order to make the subsystem used easier, the façade defines high level interface.

・Workflows: The workflow defines long term and multi step business process, and adjusts the workflow. In order to operate the transaction, this is summarized to

particular constitution element that is managed by the application server just as COM＋.

- Components: Regardless of the business process consists of single step and orchestra type workflow, “Business rule” is performed, and several components are required to achieve the said business task. These executes the “Business theory” for application, and are managed in the application server in order to operate the object pooling.
- Entities: The application generally requires that data is exchanged between components. The business entity (this is clearly used in the application) normally has the data constructions just as to lap data set, data reader or XML stream. However, they are executed using the customized object orientated class. They are generally expressing the substance in actual world that the application must operate.
- Service agents: When the component needs to use the functionality to be supplied in the external service, “Semantic management” is required in order to perform communication with the particular service. Then, the code to realize this is required to supply. The service agent recognizes the singularity, and an additional service required supplies. For example, these are the data format clarified after service execution and the basic mapping work between formats that particular application is needed.
- DALC (Data Access Logic Components): Many application and service need to access to the data memory area between business models. The DALC supplies standard and abstract methods for access to the memory system.

Like as this, Vo operates at the internet environment, and each organization is the mechanism that can execute each service as the web service described by the WSDL standard. This concept (system architecture) will be able to consider to be most suitable as the distributed collaborative environmental mechanism. Moreover, this concept complies with the descriptive system standardized like as SOAP, HTTP and XML, and encourages the interoperability.

4.3.5 Necessity of Learning Grid in Japan

New directionality in the development of GRID technology is likely to shift the frame of service orientation in accordance with the OGSA definition. This is, needless to say, integration of the web service and the GRID technology. Especially, this has open and extendable frame for the distributed collaborative application. Service action of each organizational constitution is disclosed to the users, and visibility of service action for the awareness is mandatory. Further, the expression technology at the style unified Semantics of service and the said style of protocol become

necessary. Moreover, the common interface and capsule technology to eliminate dispersion are also required. This means all service subjects such as resource, learning object, etc.

BY the way, we have observed the development of e-Learning that is mainly the Learning Grid in Europe and Britain, however actual situation of the e-Learning in Japan has been way behind of them. The seizing manner of e-Learning is too static and fixing. Therefore, it is under situation that new, developable, and extendable business model is difficult to architect. Under such problem consciousness, we would like to look over our Learning Grid way.

The writer, et. al. have been performing the research project titled “Learning-Grid of knowledge circulation orientation and systemization of new Pedagogy”. The object and purpose of this research project are the following 2 points:

Education and learning foundation with knowledge production and consumption cycle shall be the Learning-Grid, and these shall be connected with technical level, and

During the knowledge production process, new teaching management technology that interaction of learning, searching, knowledge operation and management with high freedom shall be developed.

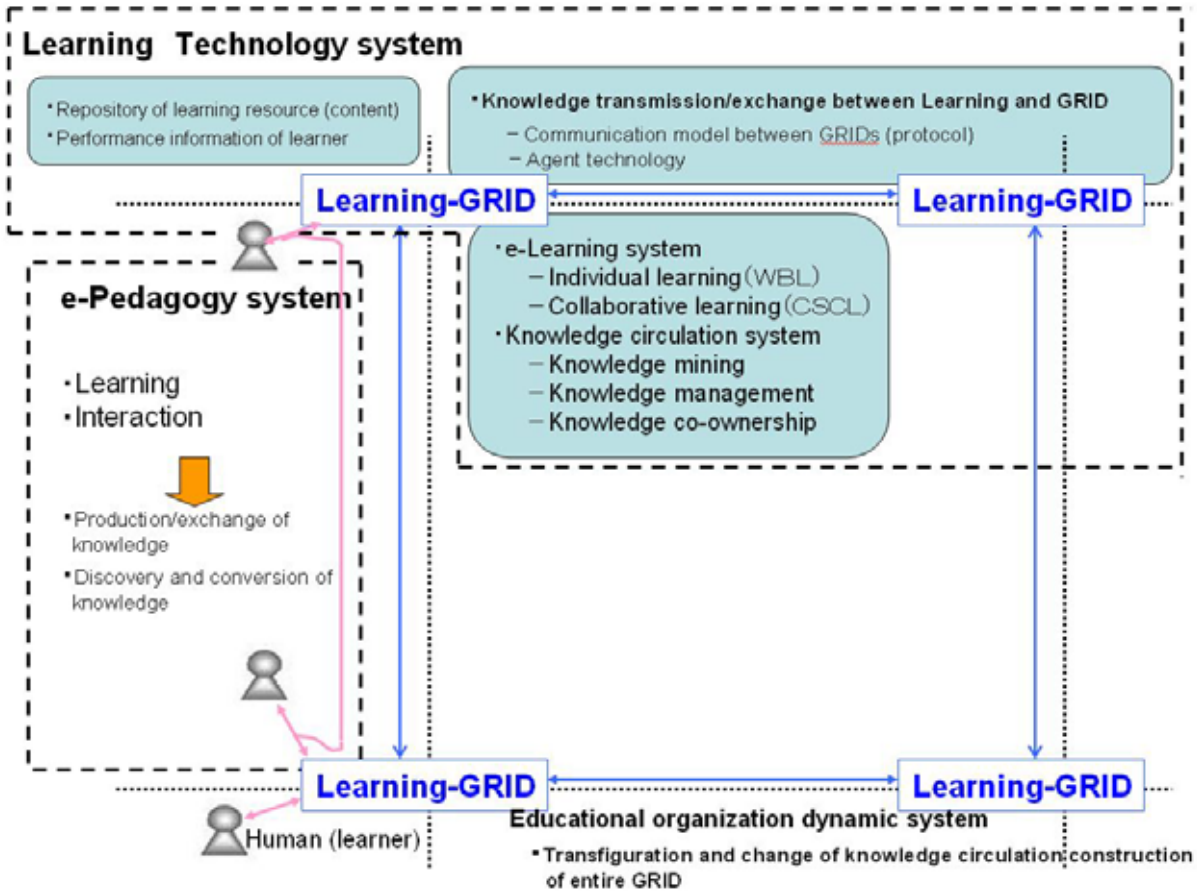

Figure 4-32　System configuration view of knowledge circulation Learning Grid

Figure 4-32 shows the entire framework. The function of educational institute in

the e-Learning Society is extremely important. In order to grow the knowledge obtained from each learning experience to the live knowledge, the action through circulation and refinement process of the knowledge as the social interaction is required. That are the e-Learning environment of growing knowledge circulation orientation that supports circulation and architecture and search and architecture of new e-Pedagogy that it can be effectively used. The life cycle of knowledge of knowledge acquisition (learning), discovery and architecture, transmission, co-ownership and reuse, and high valuation must be summarized by the viewpoint of social computing, and the effective way for the knowledge inter-transmission and absorption, that is to say, an active contact (GRID) must be architected as knowledge conversion spot.

Establishment of the constitution methodology of analytical tool, knowledge mining and collaborative learning place for realizing knowledge architecture and management. It is necessary to arrange and systemize the requirements regarding needs in knowledge society, human resource upbringing that the e-Learning society can be formed from seeds, industrial creation and organization reformation.

Before the subject realization, in the technical development, the realization of knowledge base system that non-continuous knowledge can be handled and knowledge management system that knowledge can be integrated, converted and created become an important concern. Here, the e-Learning environment to promote the autonomous and collaborative learning of learners in the digital society is handled as 1 element of the Learning Grid. BY pluralistically investigating and analyzing various teaching and learning actions that are executed in the network environment and by systemizing education, training and learning style (Ecology), it is an important to create new pedagogy that the learning activity is main, that is to say, the e-Pedagogy. In order to achieve the objective of this research project, the following 5 points have been the research target.

① Functional design of Learning Grid
② Development of communication model and communication language regarding interaction between elements in the Learning Grid (e-Learning environment, etc.) and between Learning Grids
③ Mechanism development for knowledge mining, architecture and management
④ Organization dynamic analysis of network society
⑤ Pedagogy at network society (e-Pedagogy creation)

As to these research subject, 3 systems as shown in Figure 4-22, that is to say, approach from the Learning Technology system, e-Pedagogy system and educational organization system are important. By integrating these outcomes, it is necessary to propose the Learning Grid and Japanese version e-Pedagogy along with the environment. The functions of these Grids are as follows. It is important mechanism that these functions are entirely and organically used each other.

- Learning Object repository & Metadata
- LMS/LCMS
- Knowledge management tool
- Asset management (intellectual management and effective utilization of organization)
- Data aggregation & mining

- E-Commerce function
- Search engine & Filtering function
- Navigation
- Annotation
- Right management (right management and suitable utilization)
- Authorization (validation and authorization)
- Security
- Service information & awareness information
- Agent base communication language for communication between GRIDs
- Index and evaluation criteria for performance improvement

Through the introduction of concept and design case of the Learning Grid that is the next generation learning environment, the writer explained the concept and description of new Ecology (environment and style for learning and work execution) in Pedagogy, that is to say, e-Pedagogy. The writer arranged the concept of Learning Grid, indicated the Learning Ecology that is the learning environment, also indicated the relationship with e-Pedagogy for supporting the learning action and introduced the practical and research mechanism in Britain, EU and Japan. In future, it will be necessary to specifically review all service systems in relation to the e-learning and the entire maps of agency, stakeholder, etc.

In closing, the writer would like to advise that formation of upbringing cultures of problems of not only foundation, contents, method but also upbringing and conscious reformation of enterprise managers and awareness.

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4.4 Suggestion from Committee

The committee would like to list the following 5 suggestions

(1) Architecture of Japanese version Learning GRID

In the global society, there are various concerns facing with in order to improve the Japanese industrial competitive power and to maintain the superiority, however since one superior resource in this country is “Human”, it is mandatory to largely improve the productivity of this “Human”.

Due to that, the mechanism that the activities of creation, transmission and refinement of “Knowledge” can be easily performed, must be supplied to the society. It is also necessary to fulfill the following conditions:

- to be able to seamlessly use primary education to higher education or from primary enterprise education to lifelong education,
- to be able to collaborate by exceeding the domain of school, enterprise and educational institute,
- not only simple learning but also know-how exchange and creation of idea by virtual team are possible, and
- Various rights of “Knowledge are to be guaranteed.

As the IT system to fulfill such conditions, the Japanese version Learning GRID mentioned in the Section 3 becomes necessary. Due to that, the function that each Learning GRID has and the relation between GRIDs are to be clearly designed, and it is necessary to develop tools corresponding to the systemization of collaboration environmental architecture and works and to perform the GRID foundation maintenance, etc. for resource distribution standardized.

(2) Implementation of various measures for Learning industrial promotion

The present education service (generally only “Education supply”) is too narrow domain to cover the “Knowledge”.

Therefore, it is desired to establish the systemization of comprehensive human resource upbringing that forecasts in the future (including systemization of agency and stakeholder required) and its value.

The following supports for the learners are concretely mandatory:

- Carrier design consulting
- Skill portfolio management
- Supply of learning content corresponding to carrier orientation
- Learning outcomes elucidation
- Participation to desired community
- Know-how supply for work execution
- Work execution simulation at virtual space

Further, the following functions necessary in the human resource upbringing service vendor.

- Distribution and reuse of contents
- Establishment of content value and charging system corresponding to utilization
- Community operation support

In order to respond the above, creation of business models of wider range of human

resource upbringing service and professionals upbringing in these fields are required.

(3) Reformation of human resource upbringing in enterprise

In the past, the human resource upbringing of enterprises tackled with by 3 concepts of training, OJT and self motivation. In reality, the OJT was weighed, and the forcible upbringing of “Practice makes perfect” system has been taking serious view. However, in this competitive society, since the element of “Speedy” has been added and change of business environmental conditions, etc. that cannot be tackled with by past know-how, is large, the current situation is that the upbringing cannot chase such changes. Managers and upbringing personnel have realized such statuses, and review has started of what is suitable upbringing method matching with current situation that is not past. Especially, if productivity improvement is concerned, people should learn not only low layer of “Knowledge” (basic knowledge) but must also seriously review of how high layer (work know-how) should be supplied. One of the answers is dummy experience of work and EPSS by the Learning Grid and is creation of knowledge community mentioned below, and there are 4 roles of new upbringing for “Knowledge” production by such community activities.

Furthermore, viewpoint of the human asset management is also important, and “Knowledge” does not only mean “Patent”, the human resource value should be visualized by any index, and by connecting these to upbringing outcomes and company and organization value, it becomes possible to raise inclination to the upbringing.

(4) Implementation of enterprise version GP　e-Learning project

Currently, in the higher educational institutes, the GP (e-Learning Good Practice) project has been executing, and the same project is expected to execute in the enterprises.

Concretely, about 50 companies are assumed, and by intending “Knowledge” system, the advanced tackling and new mechanism will be projecting to obtain the outcomes. The selection and evaluation points shall be as follows, and maximum outcomes are expected to fully use.

① Is there vector on “Knowledge” system?
② Can general enterprise comparatively and easily employ it?
③ Can this improve enterprise productivity?

(5) Architecture of knowledge community of productivity reformation orientation

There is community activity (mass collaboration activity) that the network is fully used as 1 solution that production reformation by breaking through traditional human resource upbringing method.

In order to create new “Knowledge”, different opinion and different interests are required, and the heterogeneity (for example, members exceeding type of business and type of job and members exceeding age and area, etc.) can be easily collected by using the network, and mutual views are expanded by exchanging debate and opinion with heterogeneity members, and possibility to create new concept becomes high. Such community germination already exists in enterprises and organizations, and has been introduced in this committee. First of all, we will start such community activity in the enterprise and organization, will obtain the outcomes by skillfully operating these, will expand the community activity exceeding the frame of enterprise and organization, and would like to obtain larger geometrical effect. And we expect that realization of the Learning GRID will expand such community activity and will upgrade further, and will expect the near future that enterprise and social productivity will improve and result in the Japanese status improvement in international society.