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Description	北陸先端科学技術大学院大学　21世紀COE プログラム「知識科学に基づく科学技術の創造と実践」

JAIST Forum 2006

- Knowledge Creation and Social Innovation -

実施報告書

平成 18 年 11 月

北陸先端科学技術大学院大学

開 催 概 要

〇日　時　　　2006 **年** 11 **月** 10 **日**(**金**)　10:30〜18:00

〇会　場　　　**北陸先端科学技術大学院大学知識科学研究科「中講義室」**

〇プログラム内容

◇10:30-10:40

Akio Makishima（Vice President, JAIST）

Opening Address and a Brief Introduction to JAIST

◇10:40-11:00

Yoshiteru Nakamori（Professor, JAIST）

A Brief Introduction to the School of Knowledge Science and a COE Program

◇11:00-12:00

Andrzej P. Wierzbicki（Professor, JAIST）

Knowledge Sciences and Nanatsudaki Model of Knowledge Creation Processes

12:00-13:30　Lunch Time

◇13:30-14:30

Robert Kneller（Professor, The University of Tokyo）

Knowledge Creation and Application in a Local Context:
Cooperation with local industry and creation of new companies.

◇14:30-15:30

Nico Stehr（Professor, Zeppelin University）

Worlds of Knowledge and Democracy: Is Civil Society a Daughter of Knowledge?

15:30-16:00　Break

◇16:00-17:00

Michael C. Jackson（Professor, The Business School at Hull）

Reflections on Knowledge Management from a Critical Systems Perspective

◇17:00-18:00

Ikujiro Nonaka（Professor, Hitotsubashi University）

The Knowledge-Creating Company: Strategy, Ba, Leadership

Strategy -as- Distributed Phronesis

写 真

○ Akio Makishima

○ Yoshiteru Nakamori

○ Andrzej P. Wierzbicki

○ Robert Kneller

○ Nico Stehr

○ Michael C. Jackson

○ Ikujiro Nonaka

講 演 資 料

＊講演順

JAIST Japan Advanced Institute of Science and Technology
Introduction

INTRODUCTION of JAIST

by

Akio Makishima
(Vice President, JAIST)

JAIST
JAPAN
ADVANCED INSTITUTE OF
SCIENCE AND TECHNOLOGY

JAIST Japan Advanced Institute of Science and Technology

Introduction

Japan Advanced Institute of Science and Technology (JAIST) was founded in 1990 as the first independent national university to carry out graduate research and education in science and technology.

President
Sukekatsu Ushioda

Ishikawa Science Park was built in the hill area of rich green Tatsunokuchi town in 1990, aiming at promoting cooperation among the government, industry, and academy in advanced technology field, and making an international research and development base.

Outline of JAIST

- Area of Campus: ~100,000m^2
- Faculty Members: ~150
- Office Workers: ∽150
- Students: ∽1000
  - Master's Program ∽ 700
  - Doctoral Program ∽ 300
- International Students: ~170
- Annual Expenditure: ∽70 MillionsUS dollar

JAIST Japan Advanced Institute of Science and Technology

Outline of Organizations

Schools

School of Information Science (since 1992 M: 264 D: 117)
School of Materials Science (since 1993 M: 250 D: 111)
School of Knowledge Science (since 1998 M: 180 D: 90)

Centers and Laboratories

Center for Knowledge Science
Center for Information Science
Center for Nano Materials and Technology
Center for Research and Investigation of Advanced Science and Technology
Research Center for Distance Learning
Internet Research Center
Center for Strategic Development of Science and Technology
Venture Business Laboratory
Health Care Center

Library

Characteristics of JAIST

- **We have three Schools and School Knowledge Science is the first School.**
-
- **High Research Levels and Many Research Projects are Conducted.**
- **For Example ,More than a half of professors are engaged in the 2COE.**
- **The Amount of Research Money per Faculty obtained is one of the highest levels in Japan**
- **Ratio of Number of Faculty to students is the highest in National Universities and Three Supervisors are assigned to a student**
- **A Student is required to take a Major and a Minor Research Projects**

JAIST Japan Advanced Institute of Science and Technology

Introduction

Our university is known for its unique educational policy. While traditional graduate schools in Japan tend to encourage early specialization, our policy is to expose the students first to a systematic course work through a carefully prepared curriculum. Our aim is to cultivate professionals with a broad background and interest to be adaptable to the quickly changing world of science and technology today. For this purpose the students are encouraged to take some basic courses, before joining a research group to specialize in a particular field.

Our admission is open to all students who have a strong motivation to advance their knowledge and ability regardless of the undergraduate background. We admit many people including professionals who want retraining in a new field, foreign students, and graduates who want a challenge in a new field. To facilitate students from diverse backgrounds, we offer several introductory courses to allow students to efficiently catch up to the frontiers of respective fields.

We aim at graduating scientists and engineers who can work effectively in global environments. For this purpose our faculty members and students are recruited worldwide, creating a campus with a cosmopolitan atmosphere in which English is used as a second language. We welcome faculty and students from all parts of the world.

School of Information Science

Department of Information Processing

Foundations of Information Science
Computational Logic
Programming Languages
Natural Language Processing
Knowledge Engineering
Artificial Intelligence
Image Information Science
Acoustic Information Science
Information Structure

Department of Information Systems

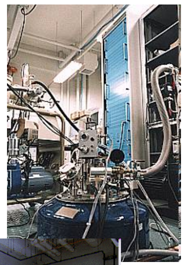
Foundations of Software
Language Design
Software Engineering
Computer Architecture
Multi-Media Systems
Computer Networks
Foundations of System Science
System Control and Management
Robotics

High Performance Database Processing Computing System (Altix)

Massively Parallel Computer (Cray-T3E)

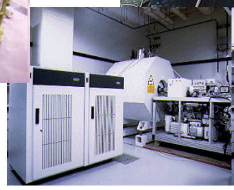
Center for Information Science

School of Materials Science



Department of Physical Materials Science

Solid State Structural Analysis
Solid State Physical Properties
Surface Science
Composite Materials
Ultra-Environmental Materials
Magnetic Materials
Semiconductive Materials
Conductive Materials



Department of Chemical Materials Science

Functional Materials Characterization
Functional Material Synthesis
Functional Separations Material
Functional Reaction Materials
Functional Optic Materials
Functional Energy Conversion Materials
Biofunctional Materials
Medical Inorganic Materials
Medical Polymers

Center for Nano Materials and Technology

School of Knowledge Science

Department of Knowledge System Science

Organizational Dynamics
Decision-Making Processes
Social Systems
Creativity Support Systems
R&D Processes
Socio-Technical System

Department of Knowledge System Science

Knowledge Creating Methodology
Knowledge-Based Systems
Knowledge Structure
Genetic Knowledge Systems
Molecular Knowledge Systems
Complex Systems Analysis

KC Air

KC Lecture

KC Studio

Center for Knowledge Science

Library

The library at JAIST provides up-to-date library materials and is open 24 hours a day as a research library in order to assist faculty members and students. Reference services for books, journals, CD-ROMs, and dissertations are available through the network to all members of JAIST. Users can obtain library information from terminals in each laboratory. The library also aims to provide access to world-wide sources in an electronic format via the Internet.

The JAIST Foundation

JAIST Japan Advanced Institute of Science and Technology

The JAIST Foundation was established in August, 1990, with the support of the business community in Ishikawa Prefecture and the Hokuriku area. The main purpose of this foundation is to support education and research ties between JAIST and industry, other academic institutions, or local public organizations. The budget of the Foundation comes from the interest on endowments (at 3.3 billion yen in March, 1999) donated by the participating corporations. Its president is Mr. Keizo Yamada.

Introduction to Ishikawa High-Tech Exchange Center

Ishikawa High-Tech exchange center, founded in October, 1993, is the host for various exchange activities in Ishikawa Science Park, whose core is Japan Advanced Institute of Science and Technology.

JAIST Japan Advanced Institute of Science and Technology
International exchanges

JAIST has concluded agreements on academic exchanges between the following 38 institutions in foreign countries in order to develop exchanges of personnel and research cooperation.

1. Royal Institution of Great Britain (UK)
2. Korea Advanced Institute of Science and Technology (Korea)
3. Novosibirsk State University (Russia)
4. Charles University (Czech)
5. University of Paris IX (France)
6. University of California, Davis (USA)
7. University of Wisconsin-Milwaukee (USA)
8. Kyungpook National University (Korea)
9. The University of Chile (Chile)
10. University of South Florida (USA)
11. Korea Institute of Science and Technology (Korea)
12. Academy of Mathematics and Systems Sciences, Chinese Academy of Sciences (China)
13. Dalian University of Technology (China)
14. Tsinghua University (China)
15. Vietnam National Center for Natural Science and Technology (Vietnam)
16. Hanoi University of Science (Vietnam)
17. Chulalongkorn University (Thailand)

JAIST Japan Advanced Institute of Science and Technology
Introduction

THANK YOU !
AND ENJOY STAYING IN JAIST

School of Knowledge Science at JAIST

Yoshiteru Nakamori

The first school established in the world to make *knowledge* a target of science.

System's ability to integrate a diversity of knowledge.

Systems Science

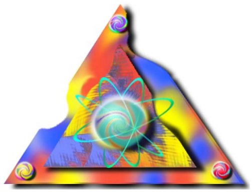
Knowledge Systems

Genetic Knowledge Systems
Molecular Knowledge Systems
Socio-Technical Systems
Complex Systems Analysis

Management Science

Knowledge Management

Organizational Dynamics
Decision-Making Processes
Social Systems
R&D Processes



Information Science

Knowledge Media

Knowledge Creating Methodology
Knowledge-based Systems
Knowledge Structure Creativity Support Systems

People's ability to understand and learn things

Computers' ability to judge things automatically

School of Knowledge Science at JAIST

Human society is becoming increasingly complex. If science remains segmented into specialized disciplines, we cannot deal effectively with multifaceted problems which we now face. Thus, we need a new integrative science that is founded on the deep understanding of humanity and society.

In view of this need, the School of Knowledge Science has embarked upon a new initiative that aims to discover both theoretical and practical principles of knowledge management (i.e., management of creating new knowledge and integrating it with existing knowledge), thereby developing new knowledge systems for decision making and problem solving.

To that end, the School has enlisted not only natural scientists and engineers but also social scientists and humanities scholars. These faculty members conduct research into:
(a) innovative methods for solving complex problems; and
(b) man-computer systems that support such problem-solving activities.

The School also provides master's and doctoral programs to educate professionals (e.g., project-team leaders and knowledge engineers) and knowledge scientists equipped with such knowledge-creating methods as fieldwork, statistical analysis, simulation, knowledge engineering, etc. They are expected to become pioneers of the knowledge society.

School of Knowledge Science at JAIST

Introductory Lectures

Introduction to Business Economics
Social Statistics
Introduction to Logic
Introduction to Mathematical Approaches
Introduction to Computer Programming
Introduction to Data Processing

Basic Lectures

Methodology for Social Sciences
Methodology of Knowledge Base
Methodology for Systems Science
Methodology of Artificial Intelligence
Innovation Management
Knowledge Theory of Physical Science
Design of Knowledge Science
Embodied Cognitive Science
Intelligent Modeling
Jaba Programming for Web Applications
Network Programming
Methodology for Knowledge Creation Systems
Methodology for Media Creation Systems

Intermediate Lectures

Theory of Knowledge Management
Knowledge Society
Comparative Study of Knowledge Institutions
Complex Systems Analysis
Knowledge Systems of Materials
Methodology for Knowledge Discovery
Representation of Knowledge
Research and Development Management
Essence of Systems Methodologies
Theory on Creation Process in Design
Design Semiotics

Advanced Lectures

Next-Generation Management of Technology
Next-Generation Knowledge Management
Socio-Technical Complex Systems
Media Environment for Knowledge Emergence
New Generation Knowledge-based Systems
Bioinformatics

The Course of Management of Technology

at Tokyo Satellite Classroom

Master Course

Since October 2002, 25 students every year

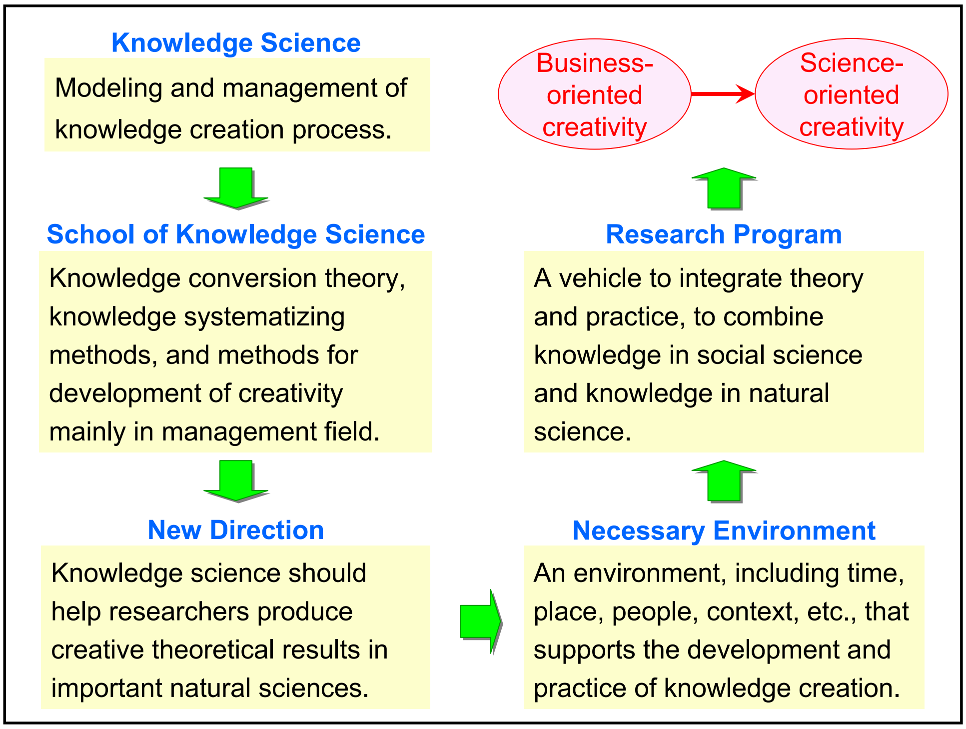
Working Experience: more than 2 years

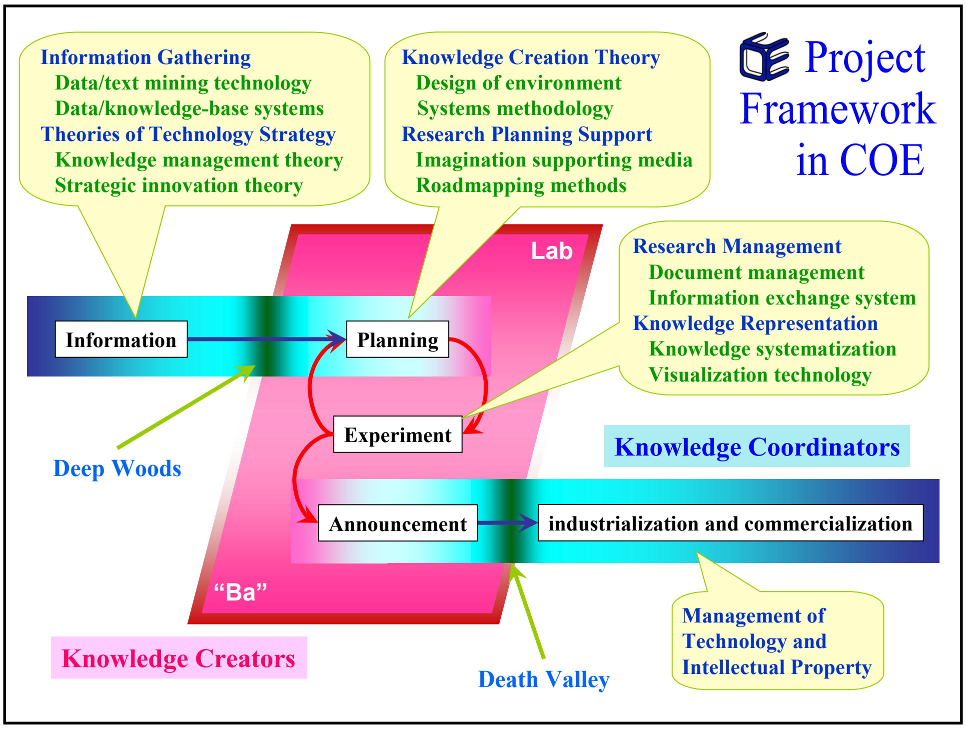
Innovation Management
Service Science
Research and Development Management
Management of Industry-Academy Collaboration
Strategic Roadmapping
Strategic Technology Management
Practice of MOT Innovation
Essence of Systems Methodologies
Management Skills in Engineers and Researchers
Technology Standardization
Intellectual Property Management
Theory on Original Concept Formation

→ Management of Technology

Methodology for Social Sciences
Methodology for Systems Science
Theory of Knowledge Management
Knowledge Society
Comparative Study of Knowledge Institutions
Knowledge-based Systems
Scientometrics
Knowledge-based Studies for Policy and Tech. Management
Technology Marketing Management
Business Accounting

→ Knowledge Science


Knowledge Science
Modeling and management of knowledge creation process.
School of Knowledge Science
Knowledge conversion theory, knowledge systematizing methods, and methods for development of creativity mainly in management field.
New Direction
Knowledge science should help researchers produce creative theoretical results in important natural sciences.
Business-oriented creativity
Science-oriented creativity
Research Program
A vehicle to integrate theory and practice, to combine knowledge in social science and knowledge in natural science.
Necessary Environment
An environment, including time, place, people, context, etc., that supports the development and practice of knowledge creation.


Project Framework in COE
Information Gathering
Data/text mining technology
Data/knowledge-base systems
Theories of Technology Strategy
Knowledge management theory
Strategic innovation theory
Knowledge Creation Theory
Design of environment
Systems methodology
Research Planning Support
Imagination supporting media
Roadmapping methods
Research Management
Document management
Information exchange system
Knowledge Representation
Knowledge systematization
Visualization technology
Lab
Information
Planning
Experiment
Announcement
industrialization and commercialization
Deep Woods
Knowledge Coordinators
"Ba"
Knowledge Creators
Death Valley
Management of Technology and Intellectual Property

The Course of Integrated Science and Technology, Since April 2005

In 2006, 12 full students, 15 part students

Courses: Master and Doctoral Course

Students: Selected Young Students
Adult Students from Industry

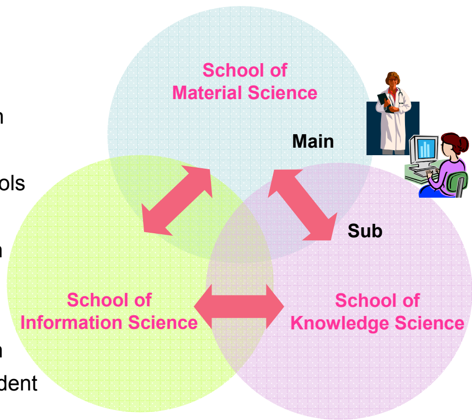
Research: Have to do the main research at a school, and do the sub research at a different school.

Subjects: Have to take subjects from 2 schools

Common Subjects:

Theory of Interdisciplinary Communication
Logical Thinking Practice
Introduction to Technology Management
Systems Theory for Regional Reactivation

Diploma: Given from the school where a student takes the main research theme



Examples of interdisciplinary research:

Study of Bioscience and Management of Technology
Material Science using Large Scale Computing
Intellectual Property Based on the State-of-the-Art in Information Technology
Approach to Environmental Problems from Technology and Economy

Integrated Science and Technology Course at the Kanazawa Satellite

15 to 20 students each year since October 2004

Wednesday evening;
Saturday morning and afternoon

Students: more than 30 years old, more than 2 years working experience

Subjects from Knowledge Science

Practice of MOT Innovation
Strategic Technology Management
Research and Development Management
Knowledge Management
Methodology for Systems Science

Subjects from Material Science

Nano-structure Control
Advanced Measurement Technology
Advanced Nano-material to Devices
Bioscience to Life Care

Final report by students inviting executives from companies

New Subject: Theory of Local Area Reactivation

August 1, 2006: Forum on Local Area Reactivation

September 16-17: Lectures and Group Discussion

October 14-15: Lectures and Group Discussion

November 12: Lectures and Group Discussion

November 13: Symposium on Local Area reactivation

Participants

Local government: 34
Local industry: 19
NPO etc.: 20
Students: 37

Reactivation Planning

Group 1: Biomass town
Group 2: Tourism
Group 3: Lacquer ware industry
Group 4: Urban renewal
Group 5: NPO
Group 6: Health and welfare

Lectures:

I. Tachi (The Cabinet Office)
Y. Wakabayashi (The Cabinet Office)
H. Suematsu (The Cabinet Office)
T. Kimura (The Cabinet Office)
S. Misono (The Ministry of Health, Labour and Welfare)
S. Kaneko (The Ministry of Economy, Trade and Industry)
K. Fujimoto (The Ministry of Agriculture, Forestry and Fisheries)

August 1, 2006: Forum on Local Area Reactivation

Koki. Tyuma
Minister of the Cabinet Office
In Charge of Restriction reform

Hiroshi Hase
Vice Minister of Education, Culture, Sports, Science and Technology

About 200 audience from outside JAIST, and about 60 students

September 16-17, October 14-15, November 12: Lectures and Group Discussion

More than 70 students from outside JAIST

Lectures by policy-makers

Group discussion

New Framework of COE Program Since October 2005

Task 1: Establishment of Knowledge Science
Study on theory of knowledge creation and development of tools to support knowledge integration and creation
Leader: K Umemoto (Knowledge Science)

Task 2: Research on Innovation
Promotion of interdisciplinary research projects
Leader: Y. Ikawa (Knowledge Science)

Task 3: Education for Innovation
Education of students who will promote innovation
Leader: M. Takagi (Material Science)

Task 4: Activities to Form a Base
Information infrastructure, evaluation systems, international academic exchange, and searching new direction
Leader: T. Yoshida (Knowledge Science)

Projects in COE

Task 1: Establishment of Knowledge Science
Project 1-A: Definition of knowledge science
Project 1-B: Development of knowledge science

Task 2: Research on Innovation
Project 2-A: Innovation in mature industries
Project 2-B: Scientific knowledge creation based on research philosophy
Project 2-C: Knowledge minimum theory for the coordinator
Project 2-D: Knowledge management in laboratories

Task 3: Education for Innovation
Project 3-A: Curriculum in the integrated science & technology course
Project 3-B: Social innovation for regional development

Task 4: Activities to Form a Base
Project 4-A: **Knowledge creation models** and knowledge maps
Project 4-B: Interdisciplinary communication and science café
Project 4-C: Evaluating systems for knowledge creating “Ba”
Project 4-D: Electronic library: knowledge-information environment

Knowledge Sciences and *Nanatsudaki Model* of Knowledge Creation Processes

Andrzej P. Wierzbicki*,** Yoshiteru Nakamori*,
*JAIST, School of Knowledge Science,
21st Century COE *Technology Creation Based on Knowledge Science,* and
** National Institute of Telecommunications

1. Changing civilization eras and changing *episteme*
2. The emergence of knowledge sciences
3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix*
4. The need and character of *prescriptive* models: the *Nanatsudaki Model*
5. The *Nanatsudaki Model: detailed elements*
6. Tests
7. Conclusions

1. Changing civilization eras and changing *episteme*

- There is a universal agreement that we are living in times of an ***informational revolution*** which leads to a new era
- Knowledge in this era plays an even more important role than just information, thus the new epoch might be called ***knowledge civilization era***
- Many other names were used: ***postindustrial, information, postcapitalist, informational, networked (society)*** *etc.*
- Between many changes, the most important one might be the changing ***episteme*** – the way of constructing and justifying knowledge
- The destruction of the ***industrial episteme*** and the construction of a new one started with relativism of Einstein, indeterminism of Heisenberg, with the concept of feedback and that of deterministic chaos, of order emerging out of chaos, complexity theories, finally – with the ***emergence principle***

1. Changing civilization eras and *episteme, 2*

- The *industrial episteme* believed in ***reduction principle*** – *that **the behavior of a complex system can be explained by the reduction to the behavior of its parts*** – which is valid only if the level of complexity of the system is rather low
- The systemic principles of ***holism*** and ***synergy*** stressed that the whole is more than the sum of its parts; but ***the change of episteme is even further reaching***
- With very complex systems today, biology, mathematical modeling, technical and information sciences adhere rather to ***emergence principle*** – ***the emergence of new properties of a system with increased level of complexity, qualitatively different than and irreducible to the properties of its parts*** (such as ***software is irreducible to hardware***)
- ***The emergence principle expresses the essence of complexity;*** it means much more than ***synergy*** or ***holism*** which concepts do not stress ***irreducibility***

1. Changing civilization eras and *episteme, 3*

- The destruction of the ***industrial era episteme*** (sometimes called not quite precisely ***positivism*** or ***scientism***) resulted in a ***divergent developments of the episteme of three cultural spheres:***
  - ***hard sciences,***
  - ***technology,***
  - ***social sciences with humanities***
- ***Hard sciences,*** since Heisenberg and Quine know that all human knowledge *"is a man-made fabric that impinges on existence only along the edges",* but they still believe that their role is to uncover that way the ***true laws of nature;*** thus they value objective aspects of knowledge, but also ***paradigms***
- ***Technology*** is less paradigmatic (follows rather ***falsificationism*** of Popper than ***paradigms*** of Kuhn) and more relativist in its episteme, admits that knowledge represents only ***man-made models of nature,*** but even ***stronger insists on objectivity as a value,*** needed, e.g., when trying to increase the reliability of contemporary cars or computer networks

1. Changing civilization eras and *episteme, 4*

- A part of ***social science*** went much further to maintain that ***all knowledge is subjective*** – ***results from a discourse, is constructed, negotiated, relativist.*** The farthest in such interpretations is ***postmodernism*** maintaining that the concept of ***objectivity*** serves only to hide the real motivations of scientific development – power and money, e.g., (Latour 1990).
- To this hard science and technology respond, however, that this denial of objectivity comes from social sciences that have themselves limited possibilities of experimental tests. Thus, this denial might be suspected to be a self-serving attempt of ***destroying the values of different cultural spheres*** because they are inconvenient for the own cultural sphere of social sciences.
- Moreover, ***objectivity*** (treated not as an absolute requirement, but as an ideal to be pursued) should be seen as ***a value, a concept emerging on a higher level of complexity of civilization development, irreducible to concepts of lower level*** – such as power and money

1. Changing civilization eras and *episteme, 5*

- ***The episteme of knowledge civilization is not formed yet, but it must include an integration***, a synthesis of the divergent episteme of these three cultural spheres – as well as a synthesis of different aspects of ***Oriental*** *and* ***Occidental episteme;*** it cannot be based on a single and extreme epistemological view, such as the episteme of postmodern social sciences.
- The integration must be based upon a ***holistic understanding of human nature: humanity is defined not only by communicating, also by tool making.***
- An attempt at such integration is made at JAIST, in the School of Knowledge Science; but the controversies presented above are deep and indicate to us that we should rather ***speak about knowledge sciences in plural, respect their diversity*** and expect their integration in future.

2. The emergence of knowledge sciences

- **A. Knowledge Management and Technology Management**

- Knowledge management has such popularity in management science that its technological origins are often forgotten. It was first introduced by computer technology firms in early 1980-ies – first in IBM, then Digital Equipment Corporation – as a computer software technology.
- From this came the tradition of treating ***knowledge management*** as a system of computer technologies. In early 1990-ies, this term was adopted by management science, and made a big career as a management discipline. This has even led to two distinct views how to interpret this term:
  - **As *management of information relevant for knowledge-intensive activities*,** with stress on information technology and knowledge engineering, etc.
  - **As *management of people in knowledge related processes,*** with stress on organizational theory, learning, types of knowledge and knowledge creation processes.

2. The emergence of knowledge sciences, 2

- It is ***correct*** that knowledge management cannot be reduced to management of information, but such ***a correct assessment is a pitfall (of binary logic):*** if you are sure to be right, it is easy to overlook both ***the complexity*** and ***the essence*** of the controversy.
- The complexity relates to the fact that knowledge management has started with technology and cannot continue without technology.
- The essence of the controversy is the fact that ***management of people*** should be also understood as ***management of knowledge workers;*** and knowledge workers are today often mostly information technologists, who should be well understood by managers. Thus, we believe that the two views listed above incompletely describe what knowledge management is; there is a third, essential view, seeing knowledge management:
  - As ***management of human resources in knowledge civilization era,*** concentrating on knowledge workers, their education and qualities, assuming a proper understanding of technologists and technology

2. The emergence of knowledge sciences, 3

- Moreover:
- Both ***knowledge engineering*** and ***technology management*** are separate disciplines from ***knowledge management*** and their practitioners often ***would not agree to be subsumed by knowledge management,*** while knowledge management specialists have a tendency to include everything what might be useful into their discipline.
- A proper, essential meaning of the word ***technology* is *the art of designing and constructing tools and technological artifacts,*** and this sense is included in the phrase ***technology management*** (Heidegger 1954, Wierzbicki 2005).
- ***Technology management*** might obviously be useful for ***knowledge management;*** but it is an older discipline, using well developed concepts and processes, such as ***technology assessment, technology foresight*** and ***technology roadmapping***. Only recently, some of these processes have been also adapted to knowledge management, see (Ma et al. 2005).

2. The emergence of knowledge sciences, 4

- **B.** All the above discussion implies that we are observing now a need for and ***an emergence process of a new understanding of knowledge sciences***
- This is not a discipline but rather interdisciplinary field that goes beyond the classical ***epistemology****,* includes also some aspects of ***knowledge engineering*** from information technology*,* some aspects of ***knowledge management*** from management and social science, some aspects of ***technology management,*** some aspects of ***interdisciplinary synthesis*** and other techniques (such as decision analysis and support, multiple criteria analysis, etc.) from ***systems science***
- This emergence process is motivated primarily by the needs of an adequate education of ***knowledge workers*** and ***knowledge managers and coordinators;*** however, also the research on knowledge and technology management and creation needs such interdisciplinary support

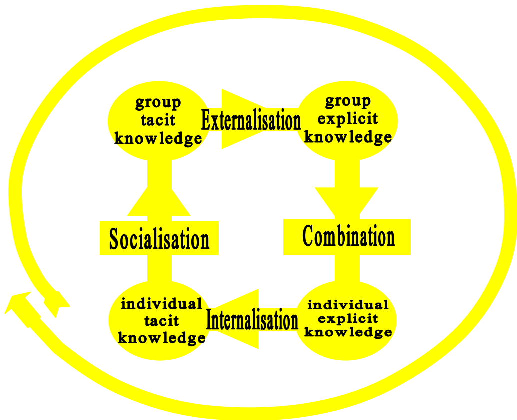
2. The emergence of knowledge sciences, 5

- To summarize, we should thus require that *knowledge sciences* give home to several disciplines (in an alphabetic order):
  - ***Epistemology,***
  - ***Knowledge engineering,***
  - ***Management science, knowledge management,***
  - ***Sociological (soft) systems science,***
  - ***Technology management,***
  - ***Technological (hard) systems science,***
- on ***equal footing,*** with a requirement of mutual information and understanding

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix*

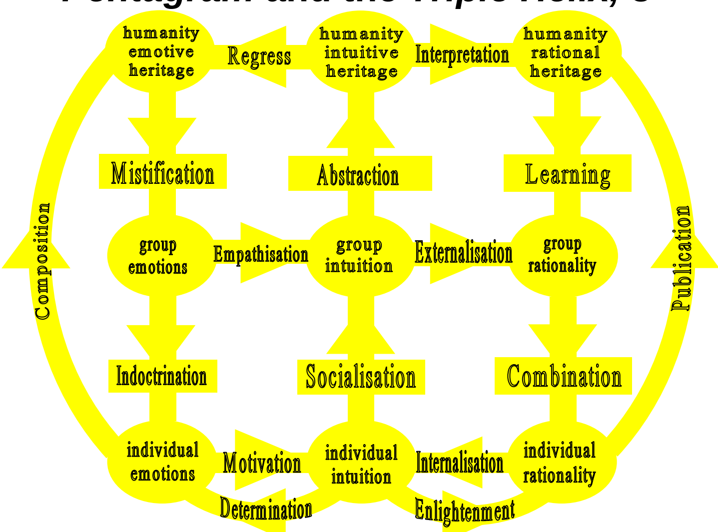
- Since the *Shinayakana Systems Approach* (Nakamori and Sawaragi, 1990) and the *Knowledge Creating Company* (Nonaka and Takeuchi 1995), many ***theories of creating knowledge for the needs of today and tomorrow*** were developed.
- We might call them ***micro-theories of knowledge creation,*** as distinct from the philosophical theories of knowledge creation on the long term, historical macro-scale that usually do not help in current knowledge creation.
- All such micro-theories take into account the ***tacit, intuitive, emotional, even mythical aspects*** of knowledge. Many of them can be represented in the form of ***spirals of knowledge creation processes,*** describing the interplay between tacit and explicit or intuitive and rational knowledge, following the ***SECI*** **(*Socialization-Externalization-Combination-Internalization*)** ***Spiral*** of Nonaka and Takeuchi.
- In Wierzbicki and Nakamori (2006), a synthesis of such micro-theories of knowledge creation takes the form of so-called ***Creative Space*** – ***a network-like model of diverse creative processes with many nodes and transitions*** between them*.* Many spirals of knowledge creation can be represented as processes in *Creative Space.*

3. The *Creative Space*, the *Knowledge Pentagram* and the *Triple Helix*, 2



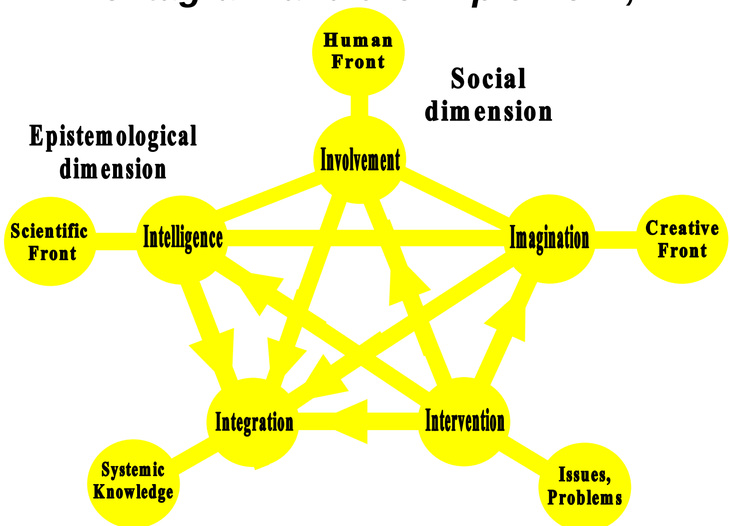
The ***SECI Spiral*** (Nonaka and Takeuchi 1995)

3. The *Creative Space*, the *Knowledge Pentagram* and the *Triple Helix*, 3



Basic dimensions of ***Creative Space*** (Wierzbicki and Nakamori, 2006)

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix, 4*



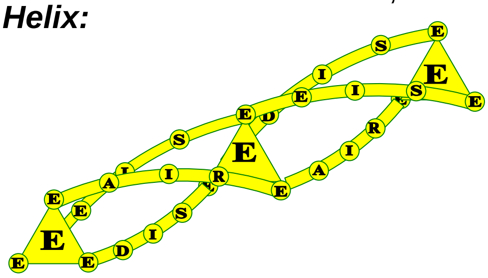
The ***I⁵* – *Knowledge Pentagram System*** (Nakamori) can be used to indicate further dimensions in the ***Creative Space*** and further spirals in this space

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix, 5*

- As a conclusion from ***Creative Space,*** we should distinguish between:
  - **group-based,** industrial ***organizational knowledge creation processes*** – such as the ***SECI Spiral,*** or its Occidental counterpart called ***OPEC Spiral*** (Gasson 2004), or an older and well known organizational process called ***brainstorming*** that can be also represented as a ***DCCV Spiral*** (Kunifuji 2005)
  - **individual-based, *academic knowledge creation processes,*** describing how knowledge is normally created in academia and research institutions.
- For the latter type, three processes of normal knowledge creation in academia are described in Wierzbicki and Nakamori (2006):
  - ***Hermeneutics*** (gathering scientific information and knowledge from literature, web and other sources, interpreting and reflecting on these materials), represented as the ***EAIR*** **(*Enlightenment-Analysis-Immersion-Reflection*) *Spiral;***
  - ***Debate*** (discussing in a group research under way, reflecting on the results), represented as the ***EDIS*** **(*Enlightenment-Debate-Immersion-Selection*) *Spiral;***
  - ***Experiment*** (testing ideas and hypotheses by experimental research, interpreting results), represented as the *EEIS* **(*Enlightenment-Experiment-Interpretation-Selection*) *Spiral.***

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix,* 6

- The three activities:
  - 1) reading and interpreting;
  - 2) experimenting;
  - 3) debating
- are obviously essential for normal science creation. The corresponding three spirals – ***hermeneutic EAIR, experimental EEIS*** and ***debating EDIS*** - can be performed parallel or switched between: thus, we can present them as the ***Triple Helix:***



- Triangles: switch between spirals
- Small circles: transitions in spirals

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix,* 7: *Hermeneutics*

- The humanistic concept of ***hermeneutics*** (interpreting texts) describes the most basic activity for any research – that of gathering from outside sources relevant information and knowledge, interpreting them and reflecting on them.
- A full cycle of the ***most individual EAIR Spiral*** consists of:
  - ***Enlightenment****,* having a research idea, then following it with ideas where and how to find research materials;
  - ***Analysis,*** which is a rational analysis of the research materials;
  - ***Hermeneutic Immersion,*** which means some time (***Ma***) needed to absorb the results of analysis into individual intuitive perception of the object of study;
  - ***Reflection,*** which denotes intuitive preparation of the resulting new ideas.
- Hermeneutics is well recognized in humanistic studies; the novel aspects of ***EAIR Spiral*** are ***closing the hermeneutic circle by the power of intuition,*** and stressing the ***universal role of hermeneutics in knowledge creation,*** also in hard science and in technology, not only in humanistic studies.

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix, 8: Debate*

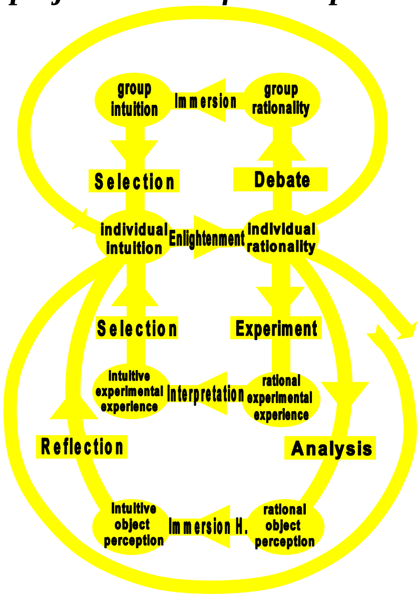
- ***Intersubjective*** *EDIS Spiral* describes also one of the most fundamental and well known processes of normal knowledge creation in academia:
- ➢ After having an idea due to the ***Enlightenment*** phenomenon, an individual researcher might want to check it intersubjectively,
- ➢ Scientific ***Debate*** actually has two layers: one is verbal and rational, but after some time for reflection (***Ma*)** we also derive intuitive conclusions from this debate.
- ➢ This is the extremely important and in fact difficult transition called ***Immersion*** (of the results of debate in group intuition)*;* it occurs as a transition from group rationality to group intuition*.*
- ➢ An individual researcher does not necessarily accept all the results of ***group intuition****,* she or he makes his own ***Selection*** in the transition from group intuition to individual intuition.
- This process can gain momentum by repetition: second ***Debate*** might be much enriched by group intuition resulting from ***Immersion*;** this is called the ***Principle of Double Debate***.
- Again, this academic knowledge creation process is well known; new is ***stressing the interplay of rational and intuitive aspects of knowledge,*** emphasizing the power of ***Immersion*** and the ***Principle of Double Debate*.**

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix, 9*: *Experiment*

- Academic knowledge creation is not only hermeneutic and intersubjective; in many disciplines it requires also experimental research. This is described by a corresponding ***experimental EEIS Spiral*** that also starts with:
- The transition ***Enlightenment,*** this time indicating the idea of an experiment,
- followed by ***Experiment*** performing the actual experimental work,
- then by ***Interpretation*** of the experimental results reaching into intuitive experimental experience of the researcher,
- finally ***Selection*** of ideas to stimulate a new ***Enlightenment.***
- This cycle can be repeated as many times as needed, but usually requires support: ***adaptive experiment planning, experiment reporting****,* etc.
- Novel is not the well known process, but its ***interpretation as a spiral, an interplay of rational and intuitive knowledge.***
- Experiment is the basis of ***objectivity, understood*** not as the requirement of a positivist truth, but ***as a goal*** of developing theories that correspond as adequately as possible to experimental facts, ***as a value*** shared by hard sciences and technology (not necessarily by postmodern social sciences).

3. The *Creative Space,* the *Knowledge Pentagram* and the *Triple Helix, 10*

- *A projected view of the Triple Helix:*



4. The need and character of *prescriptive* models: the *Nanatsudaki Model,* 1

- ***Descriptive models constitute knowledge (typical for science); prescriptive models are tools (typical for technology).*** E.g., MS Powerpoint is a prescription how to prepare overheads. We need both!
- The ***Triple Helix*** indicates that ***normal academic research processes*** are essentially different than ***organizational knowledge creation processes,*** typical for business, industry, goal-oriented organizations, such as described by:
- ➢ The ***SECI Spiral*** (organizational, but of Oriental character);
- ➢ The ***OPEC Spiral*** (organizational, but of Occidental character);
- ➢ The ***Brainstorming DCCV Spiral*** (goal-oriented, of cross-cultural character, the oldest organizational knowledge creation process, represented as a spiral by Kunifuji 2004);
- ➢ The ***Roadmapping I⁵ Spiral*** (another interpretation of the Pentagram System of Nakamori, goal-oriented, with the purpose of roadmapping or detailed planning of knowledge creation processes)

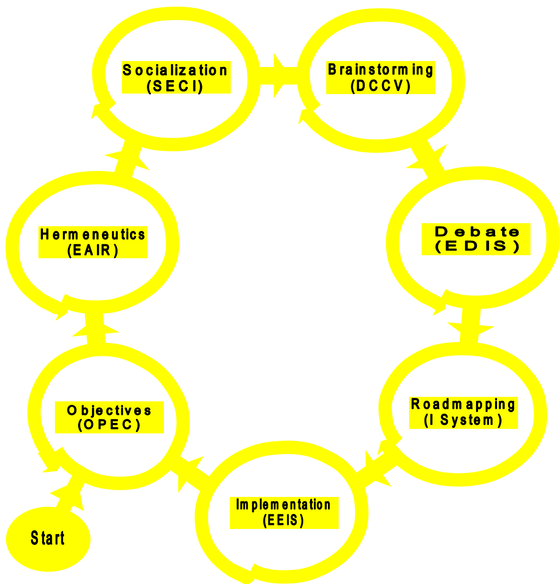
4. The need and character of *prescriptive* models: the *Nanatsudaki Model,* 2

- ***Problem:*** how to combine normal academic and organizational knowledge creation processes, in order to:

1. **Help in cooperation between academia and industry;**
2. **Provide a tool for addressing ambitious, difficult knowledge creation tasks.**

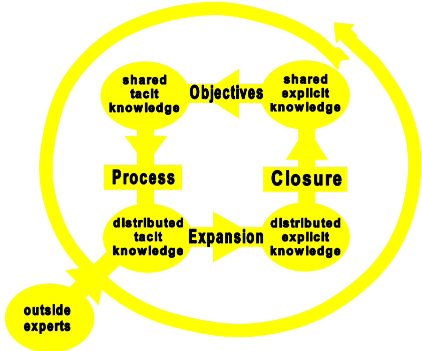
- ***Proposed Solution:*** combine seven spirals of knowledge creation, in a sequence resulting from experience in science management.
- ***Resulting Model:*** a cascade of seven spirals, thus called ***Nanatsudaki Model of knowledge creation processes*** (originally *Nanatsudaki* denote seven waterfalls on *Asahidai* hill close to *JAIST*)
- ***Proposed Sequence: OPEC – EAIR – SECI – DCCV – EDIS –*** $\boldsymbol{I^5}$ ***– EEIS,*** with possible repetitions.
- In other words: **set objectives – study literature – socialize – brainstorm – debate – plan detailed research – experiment – repeat,** all the time remembering the interplay of irrational and rational aspects of research.
- **Assumption for this version of *Nanatsudaki Model*:** the knowledge creation task is based on extensive experiments.

4. The need and character of *prescriptive* models: the *Nanatsudaki Model,* 3



5. The *Nanatsudaki Model: 1) Objective Setting*

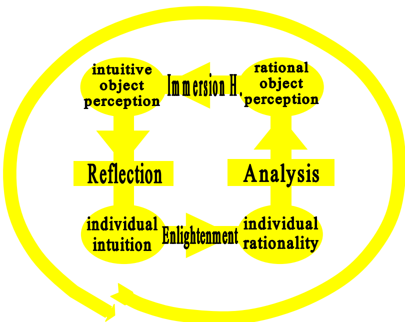
- **1) *OPEC Spiral*** (Gasson 2004): **Objective setting.**



- No need to go through entire ***OPEC Spiral:*** the functions of ***Expansion*** (similar to ***Enlightenment***) and of ***Closure*** will be addressed more thoroughly by other spirals. But an outline of ***Objectives*** (setting objectives of research) and of ***Process*** (outlining the stages of the process) is necessary.

5. The *Nanatsudaki Model: 2) Hermeneutics*

- **2) *Hermeneutic EAIR Spiral* – reading, interpreting and reflecting** (described earlier). In stage 2), all members of the group working on a research project should start hermeneutic activity.
- This does not mean they this activity is restricted only to stage 2; it should continue parallel to all further stages; but it is essential that some research materials are gathered and reflected upon before the stage 3. Thus, here at least one full cycle of the ***EAIR Spiral*** should be completed.

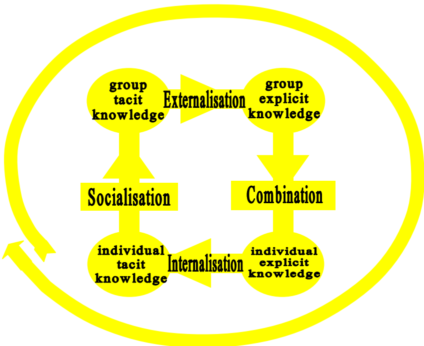


5. The *Nanatsudaki Model: 2) Hermeneutics*

- The transition ***Enlightenment*** corresponds here first to ideas where and how to find research materials; ***Analysis*** is a rational analysis of the research materials, ***hermeneutic Immersion*** means some time necessary to interpret and absorb the results of analysis into individual intuitive perception of the object of study, ***Reflection*** means intuitive preparation of the resulting new ideas.
- Further repetitions of the spiral should go on parallel to other activities. ***Hermeneutics*** is the most individual research spiral, but its importance should be well understood even in fully industrial group-based research.
- ***Hermeneutic EAIR Spiral*** using dimension ***Reflection*** might be the most fundamental for normal academic knowledge creation, but also for any knowledge creation.

5. The *Nanatsudaki Model: 3) Socialization*

- **3)** ***SECI Spiral*** **– Socialization*.*** We could perform here all transitions of ***SECI Spiral***, as presented earlier, see e.g. Nonaka and Takeuchi (1995); but most important in our context is ***Socialization.***



5. The *Nanatsudaki Model: 3) Socialization*

- We give here a slightly different interpretation of these transitions:
- ***Socialization,*** which actually means sharing intuitive perceptions in an informal meeting;
- ***Externalization,*** which can be explained as rationalizing the intuitive knowledge of the group;
- ***Combination,*** developing detailed plans and directives for individual group members;
- ***Internalization,*** increasing individual intuitive perception – tacit knowledge - while learning by doing.
- However, in the ***Nanatsudaki Model*** we can use spirals in further stages to perform in more detail the function of either ***Externalization*** (as in ***Brainstorming*** and in ***Debate***) or of ***Combination*** (as in ***Roadmapping***) or even of ***Internalization*** (as in ***Implementation***). Thus, the entire ***Nanatsudaki Model*** can be interpreted as an enhanced ***SECI Spiral***.
- In its separate part that is directly related to ***SECI Spiral*** it is sufficient to perform only the ***Socialization***. It is, however, an important part; without ***Socialization***, the following ***Brainstorming*** and ***Debate*** might be not very effective.

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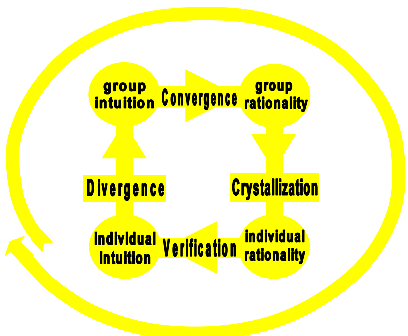
5. The *Nanatsudaki Model: 4) Brainstorming*

- **4) *Brainstorming DCCV Spiral* – Divergence.** The full cycle of the *DCCV Spiral* can be performed:
  - ***Divergence:*** generating and listing as many ideas as possible;
  - ***Convergence:*** selecting most helpful ideas;
  - ***Crystallization:*** improvement of the best ideas;
  - ***Verification:*** applying and thus testing these ideas;
- but in the ***Nanatsudaki Model,*** concentration on the ***Divergence*** transition suffices.



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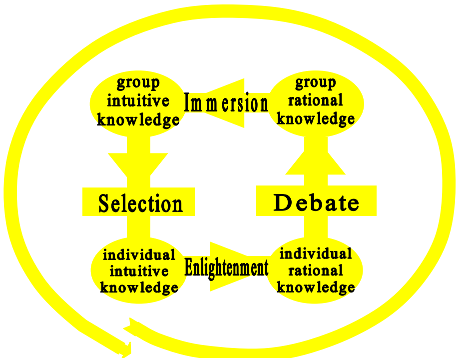
5. The *Nanatsudaki Model: 4) Brainstorming*

- This is because the ***Divergent*** thinking transition is essential here to generate as many and as wild ideas as possible, and ***Convergent*** thinking is helpful to organize these ideas, but further transitions of ***Crystallization*** and of ***Verification*** are in more detail supported by the next spiral of ***Debate*** and the final spiral of ***Experiments****.*
- However, the ***Divergent*** thinking transition is extremely important for the success of the entire creative process: it mobilizes the full imaginative power of the group to generate new ideas.
- During this transition, we should fully observe the rules of divergent thinking – ***do not criticize, develop creatively even the wildest ideas.*** However, the next ***Convergent*** thinking transition requires switching back to a critical and synthetic attitude; since this never occurs easily, it is better to switch to another spiral for the ***Crystallization*** of ideas.

5. The *Nanatsudaki Model: 5) Debate*

- **5) *Debating EDIS Spiral* – Critical Debate** (described earlier). We use the transition ***Debate*** for a rational organization of ideas. We separate this stage from the former ***Brainstorming*** by some time (***Ma***) in order to immerse the results of the former stage into intuition of project participants.



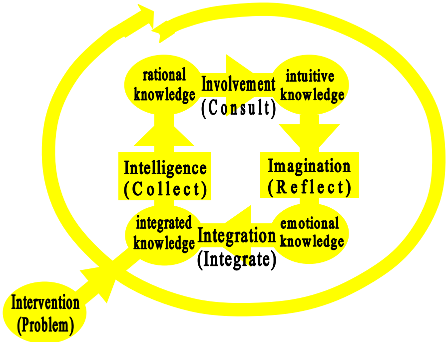
5. The *Nanatsudaki Model: 5) Debate*

- The debate is a part of detailed realization of the difficult stages of ***Combination*** from ***SECI Spiral*** or ***Crystallization*** from ***DCCV Spiral:*** a list of ideas defined by groupwork must be made clear enough for every member of the group, and there is no better method for realizing that objective than questioning and debating.
- Again, it must be stressed that a well organized ***Debate*** is crucial: the members of the group must realize that they must switch their mind-sets, abandon the uncritical attitude of the former stage of ***Brainstorming*** and start an open though constructive questioning of every assumption and of every doubt, in order to achieve a true ***Crystallization*** of ideas.

5. The *Nanatsudaki Model: 6)Roadmapping*

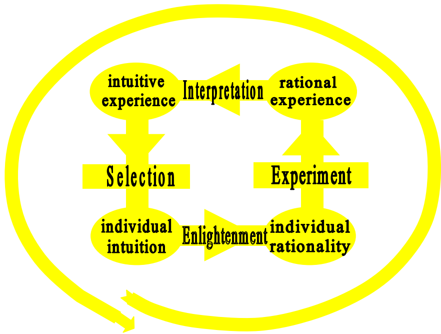
- **6) *Roadmapping I^5 Spiral* – detailed planning of further research:**

➢ ***Intelligence:*** summarizing all results of individual hermeneutic activities for the group use;
➢ ***Involvement:*** consultations with the future users of the results of research project;
➢ ***Imagination:*** immersing the consultation outcomes, preparing the ground for a new integration;
➢ ***Integration:*** working out a mature form of the roadmap for further research activities.



5. The *Nanatsudaki Model: 7) Experiments*

- **7) *Experimental EEIS Spiral* – perform detailed experiments** (explained earlier).



5. The *Nanatsudaki Model: 7) Experiments*

- Recall that the spiral consists of the transitions:
- ***Enlightenment*** meaning the creation of an idea of an experiment;
- ***Experiment*** performing the actual experimental work;
- ***Interpretation*** of the experimental results reaching into intuitive experimental experience of the researcher;
- ***Selection*** of ideas to stimulate a new ***Enlightenment****.*
- This cycle should be repeated as many times as needed and with such support as needed.
- The support should include interactive experiment planning; although the former stage of ***Roadmapping*** includes preliminary experiment planning, the results of current experiments and their interpretation always – at least, in a creative experimental work – imply changes in experiment planning.
- The support should include also experiment reporting, an extremely important aspect of experimental groupwork.

5. The *Nanatsudaki Model: 8) Closure*

- **8) *Closure: a different cycle of entire process***
- How the process of ***Nanatsudaki Model*** should end? A report of results obtained, a reflection on this summary of results, on their possible future implications and use, is always necessary upon completing a research project or an important stage of it.
- ***We suggest to use for this purpose another cycle of the entire Nantsudaki Model process,*** suitably modified and shortened, if necessary, to fit the purpose of reporting or to summarizing the results.
- For example, a new ***Socialization*** might be used to informally exchange ideas about the importance and future applications of results; ***Brainstorming*** might be performed again, if some future applications deserve it; ***Debate*** might help in the best summary and presentation of entire project; ***Roadmapping*** and ***Implementation*** might be not needed, but a review of original roadmap comparing it with actual developments might be helpful in reporting.

6. Tests

- A question might be asked: ***why did we select precisely these*** creative spirals and this particular order of them? We can answer that we did it ***on the basis of our intuitive, tacit knowledge, resulting from many years of our experience in the management of research activities,*** and that the validation of any prescriptive model requires its application. However, even if such response gives some justification to the ***Nantsudaki Model,*** it does not provide its full substantiation.
- Therefore, we validate the ***Nanatsudaki Model*** in several stages. One is already performed and consisted in a survey of opinions about creativity conditions between young researchers – master students, doctoral students and research associates – at JAIST.
- The purpose of the survey was to find what aspects of knowledge creation processes are evaluated as either ***most critical*** or ***most important*** by responders.
- On this occasion, we tried also a new approach to ***interactive knowledge acquisition from complex data bases.***

6. Tests, 2

- A long questionnaire was prepared (J. Tian); it consisted of total of 48 questions, organized in five parts.
- The questions were of three types:
  - ***Assessment questions****,* assessing the situation at the university; the ***most critical*** questions of this type are those that correspond ***worst*** to a given reference profile.
  - ***Importance questions****,* assessing importance of a given subject; the ***most important*** questions might be considered as those that correspond ***best*** to a reference profile.
  - ***Controlling questions****,* testing the answers to the first two types by indirect questioning revealing student attitudes or asking for a detailed explanation.
- The responders were subdivided corresponding to:
  - The organizational structure of JAIST, three schools: of material science, of information science and of knowledge science;
  - Their character: master students, doctoral students, research associates;
  - Their national origin: Japanese and foreign.

6. Tests, 3

- All questions of first two types – ***assessment questions and importance questions*** – allowed five options of answers, variously called but signifying similar opinions: “very good – good – average – bad – very bad” or “very important – important – indifferent – not important – negatively important”. Thus, answers to all questions of first two types can be evaluated on a common scale, as ***a percentage statistical distribution of answers*** *VG – G – A – B – VB,* while a different wording of the answers would be appropriately interpreted.
- Some questions or scale of answers were reversed, stated negatively, for testing the concentration of responders, but this can be also taken into account just by reversing the scale. Special attention should be paid to:
- ***The worst evaluated assessment questions*** of the first type, indicating some ***critical conditions*** for scientific creativity;
- ***The best evaluated importance questions*** of the second type, indicating ***most important issues*** in the opinion of responders.
- Thus, the problem might be posed as a ***ranking of histograms or probability distributions***

6. Tests, 4

- A special ***reference profile*** (or ***reference distribution,*** since it has a statistical interpretation) ***approach to knowledge discovery in data bases*** was developed for ranking the answers to the questions, finding the best and the worst evaluated questions
- The issue of ***objective ranking*** was also included (in interactive decision making, every ranking is subjective; but in experimental testing a theory, or even when ranking the importance of issues for management, we need as much objectivity as possible)
- A special software system (H. Ren) was developed for computing the distributions of answers, defining and changing reference profile distributions, computing ranking lists of questions, repeating these computations for all or part of responders – e.g., for foreign students, or doctoral students, or students of a given School of JAIST, etc.
- For research reasons, beside two achievement functions (…), four different types of reference profile distributions were compared: ***Average -*** actual average of all responders and questions, which results in a statistical objectivity in a given data set; ***Regular, Demanding,*** and ***Stepwise -*** artificial distributions devised for testing

6. Tests, 5

- Both types of achievement functions, with various parameter values and with these four reference distributions were used and the results compared. This ***variety of ranking approaches:***
  - Two types of achievement functions;
  - Four values of parameters for each achievement function;
  - Four reference distributions;
- was compared in order to test ***the robustness of conclusions***
- **It was found that:**
- Changing the achievement function or the type of reference distribution does not essentially, qualitatively change the questions evaluated as ***worst, most critical;*** it influences, although in some sense predictably, the ***best, most important*** or best provided for.

6. Tests, 6

- In eight worst evaluated questions, almost all (seven) were consistently repeated independently of these changes; thus, we can count them as the ***most critical*** questions of the first type. These are questions related to not good enough situations concerning:

1) Because of language reasons, difficulty in discussing research questions with colleagues from other countries;
2) Easiness of sharing tacit knowledge;
3) Critical feedback, questions and suggestions in group discussions;
4) Organizing and planning research activities;
5) Preparing presentations for seminars and conferences;
6) Designing and planning experiments;
7) Generating new ideas and research concepts.

- In the eight best evaluated questions, the following questions of the second (importance) type were consistently, independently of these changes, listed as ***most important***:

1. Learning and training how to do experiments;
2. Help and guidance from the supervisor and colleagues;
3. Frequent communication of the group.

6. Tests, 7

- Most of these results actually correspond to some elements of the three spirals of normal academic knowledge creation:
  - ***Intersubjective EDIS*** **(*Enlightenment-Debate-Immersion-Selection*)** ***Spiral*** – items 2), 3) and 5);
  - ***Experimental EEIS*** **(*Enlightenment-Experiment-Interpretation-Selection*)** ***Spiral*** – item 6);
  - ***Hermeneutic EAIR*** **(*Enlightenment-Analysis-Immersion-Reflection*)** ***Spiral*** – item 7).
  - However, they also stress the importance of another spiral of research planning: ***Roadmapping*** **(*I-System*)** ***Spiral*** – item 4).
- This conclusion is supported by the positive evaluation of the *importance* of other elements of these spirals in response to questions of the second type (1., 2., 3.) – and also by the answers to *indirect questions* of the third type.
- The question, however, is: ***how objective*** is such empirical support for the essential importance of the three spirals of normal academic knowledge creation contained in the ***Triple Helix*** and the ***Roadmapping Spiral?***

6. Tests, 8

- It is just common sense that:
  - ➢ reading scientific literature,
  - ➢ debating,
  - ➢ experimenting,
  - ➢ research planning
- are ***normal*** elements of academic research (***to falsify this, find a university that functions without them***).
- However, even a positive, as objective as possible empirical support from one research institution cannot prove that these elements are ***essential for all universities;*** many falsification attempts are needed to be reasonable sure of their importance, further research is necessary.
- Thus, other tests are intended; they might consists in an application of the full cycle of the *Nanatsudaki Model* in a research project; or performing similar questionnaire research in other research institutions.

6. Tests: conclusions

- The example of the evaluation of the results of the survey of conditions for scientific creativity shows that ***the proposed method can be very useful for management,*** as in the particular case it was found useful by university management:
  - ➢ In identifying several issues of creativity that might be improved, e.g., by introducing new teaching courses;
  - ➢ In detailed critical comments from individual responders.
- Other conclusion from this example is ***a (naturally limited) empirical support for the essential importance of the four spirals*** :
  - ➢ ***the Intersubjective EDIS Spiral,***
  - ➢ ***the Experimental EEIS Spiral,***
  - ➢ ***the Hermeneutic EAIR Spiral,*** and also:
  - ➢ ***the Roadmapping (I-System) Spiral*** of planning research processes.
- In general, this example shows that the use of ***interactive knowledge acquisition –*** that is, a multiple criteria formulation and reference profiles for knowledge acquisition from complex data sets - gives very promising results and should be applied more broadly.

7. Conclusions - general

- We commented on the emergence of ***knowledge sciences,*** including ***epistemology, knowledge engineering, management science with knowledge management, sociological*** (*soft*) ***systems science***, ***technology management, and technological*** (*hard*) ***systems science.***
- Many new ***micro-theories*** of knowledge creation for today and tomorrow emerged since 1990. All such micro-theories take into account the interplay of intuitive and emotional, tacit aspects of knowledge with rational and explicit aspects.
- There is a qualitative difference between group-oriented ***organizational*** processes of knowledge creation in industrial and market organizations and individual-oriented ***academic*** processes of knowledge creation; the latter can be described by a ***Triple Helix*** of academic knowledge creation.
- Combining both organizational and academic processes of knowledge creation is the prescriptive ***Nanatsudaki*** model of seven creative processes.
- The importance of diverse elements of these models was empirically supported by the results of a survey of creativity conditions in a Japanese research university, using multiple criteria decision making for ***interactive knowledge acquisition*** from complex data bases.

Knowledge Creation and Application in a Local Context:

Cooperation with local industry and creation of new companies .

JAIST Forum 2006

Presentation by Robert Kneller

University of Tokyo, RCAST

www.kneller.jp, email: kneller@ip.rcast.jp

Part 1: INTRODUCTION

Practical point: Knowledge creation and exploitation depends upon

- Career opportunities and career incentives
- Financing of R&D

With respect to these factors

- How do peripheral regions in Japan compare with Japan's major metropolitan centers?
- How do Japanese ventures compare with ventures in the US?

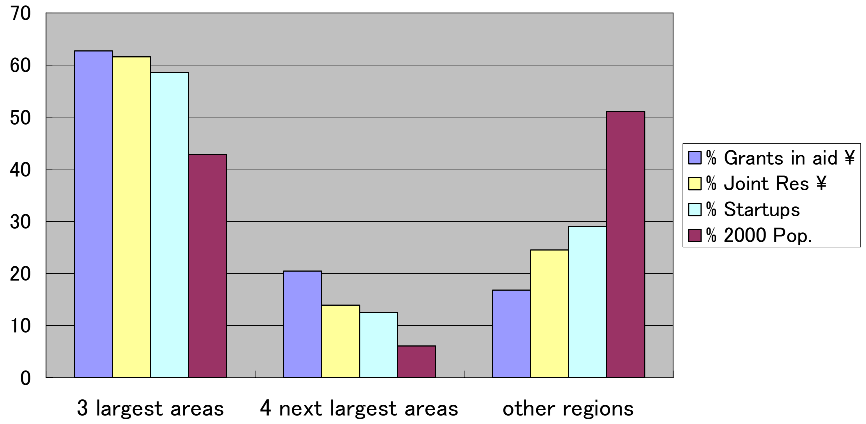
Monbusho/MEXT Grants-in-aid (all types, new and continuing projects)

	1995			2005		
Rank	University	Amount (10^8 yen)	% of total	University	Amount (10^8 yen)	% of total
1	U of Tokyo	125.5	13.6	U of Tokyo	201.2	11.7
2	Kyoto U	72.7	7.9	Kyoto U	131.1	7.6
3	Osaka U	61.3	6.6	Tohoku U	94.8	5.5
4	Tohoku U	41.6	4.5	Osaka U	89.8	5.2
5	Nagoya U	34.9	3.8	Nagoya U	64.6	3.8
6	Kyushu U	30.0	3.3	Kyushu U	56.8	3.3
7	Tokyo Inst. Tech	30.0	3.2	Hokkaido U	56.1	3.3
8	Hokkaido U	28.5	3.1	Tokyo Inst. Tech	45.4	2.7
9	U of Tsukuba	22.2	2.4	U of Tsukuba	30.2	1.8
10	Hiroshima U	13.2	1.4	Riken	26.3	1.5
11	Okayama U	9.5	1.0	Keio U	24.9	1.5
12	Keio U	9.1	0.9	Kobe U	24.7	1.4
Total		924.0	100		1714.4	100

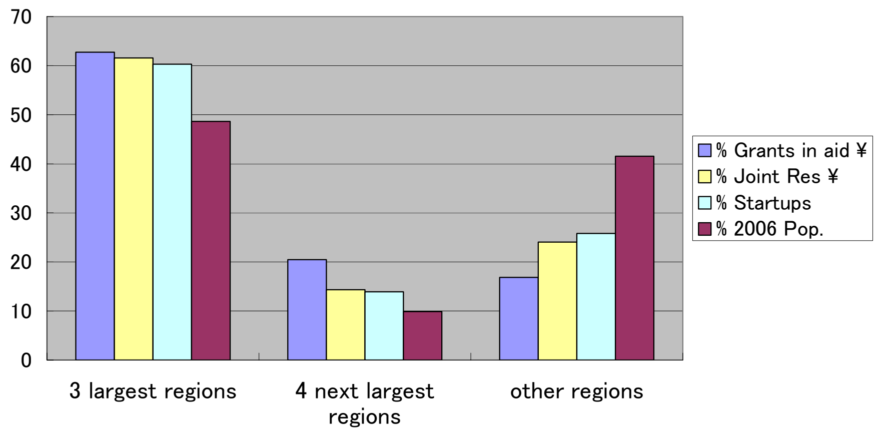
US academic institutions ranked by 2003 Federal R&D funds ($ million)

All source rank and university name	All sources	Federal gov't	% total Federal	State/loc gov't	Industry
1 Johns Hopkins U. incl. APL (private)	1,244	**1,007**	**4.47**	3	20
4 U. of Washington–Seattle	685	**566**	**2.29**	12	48
2 U. of Michigan, all campuses	780	**517**	**2.09**	17	36
8 Stanford U. (private)	603	**484**	**2**	4	31
2 U. of California–Los Angeles	849	**421**	**1.7**	67	30
9 U. of Pennsylvania (private)	565	**416**	**1.68**	2	27
6 U. of California–San Diego	647	**400**	**1.62**	24	29
3 U. of Wisconsin–Madison	721	**396**	**1.6**	41	16
23 Columbia U. (private)	438	**386**	**1.56**	2	5
24 U. of Colorado, all campuses	437	**378**	**1.53**	8	10
6 U. of California–San Francisco	671	**372**	**1.5**	27	37

University Grants-in-aid, Joint Research, Startups and Population by Metro-area-defined Regions



University Grants-in-aid, Joint Research, Startups and Population by Prefecture-defined Regions



Over 80% of government funding for university R&D, about 75% of private funding for university R&D, and 70% of entrepreneurial activity

are concentrated in 7 population centers that account for about half Japan's population.

Why might startups be especially important for regional universities?

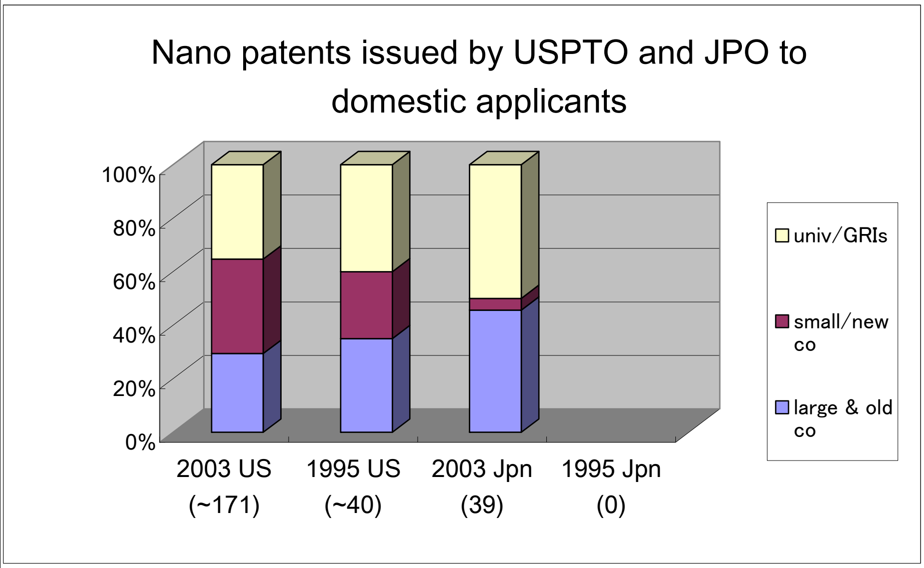
- Few existing local companies can develop regional university discoveries.
- Even if distant (Tokyo, Osaka, etc.) companies can be found, control over development will slip away.
  - Few high value added jobs created locally.
  - Reduced opportunities for technological development in region.
- Entrepreneurial drive may be more evenly distributed than government or corporate R&D support.

Comment from the Director of the University-Industry Liaison Office of a major Canadian university:

“Canada has no large [pharmaceutical] companies. The only alternative to licensing our university’s [biomedical] discoveries to US companies is to create our own startups and to help them grow. This is the only way to keep good jobs and value-added development in our region.”

But in Japan as a whole, the role of high technology startups is more limited than in the U.S.

- As are their business prospects.



Leading Firms with Nanotube Electronics Programs and Products

- Japanese: Fujitsu, Hitachi, Mitsubishi, NEC, Noritake, NTT
- US large: DuPont, General Electric, IBM, Intel and Motorola/Freescale
- US ventures: Eikos, Molecular Nanosystems (Stanford), Nanomix (UC Berkeley), Nano-Proprietary, Nantero (Harvard) and Xintek/Applied Nanotech (U. N.Carolina)
- Other: Samsung, Infineon (Siemens spin-off)

Recruitment of skilled managers and R&D personnel is a major problem for Japanese high technology ventures

The most numerous and successful startups are in biomedicine, but

- Total employment in therapeutic-oriented ventures (~1500 in 113 cos., avg age 4 yrs) in 2005 was less than half that in US bio ventures of equivalent age in 1987 & 1998.
- Average employment per co. in 2005 about 1/3rd that in equivalent-age bio ventures in US.

What options for strong regional universities to increase knowledge creation and exploitation?

- Increase core academic capabilities
- Increase cooperation with existing companies*
- Increase and nourish startups*
  - The isolation of regional universities may paradoxically be an advantage for startups

* Focus of remainder of talk

Part 2: Practical steps

many of which are now being implemented*

A. Outreach to industry
B. Streamlining joint research administration
C. Internships in industry for students
D. MBA and MOT programs to (a) educate students and local businessmen and (b) improve outreach to local businesses
E. Facilitate startup formation and growth

***These steps were independently conceived by JAIST faculty. Much of the following reflects JAIST's ideas and actual accomplishments as part of the JAIST COE project.**

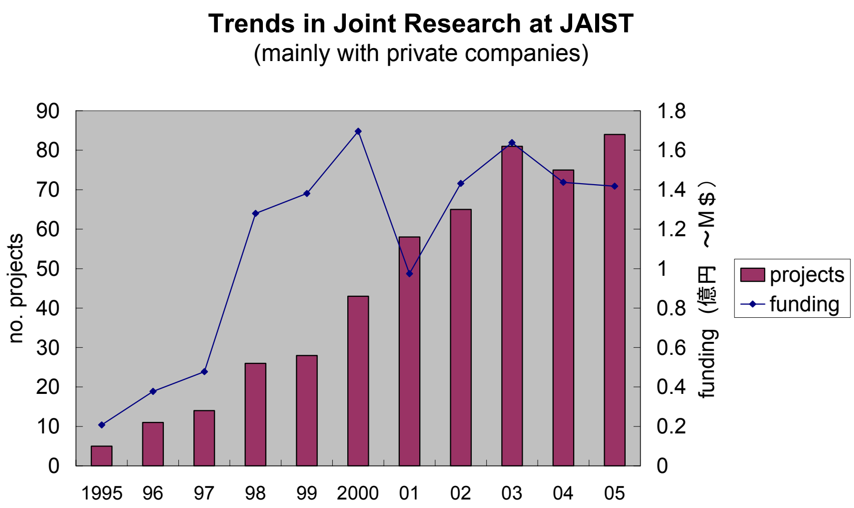
A. Outreach to existing companies*

- Industry-university cooperation center established in JAIST
  - 2 staff: industry coordinator from prefectural government and a businessman
  - Focusing on linking materials science faculty with local businesses,
    - at least one ongoing collaboration related to ceramic dyes.
  - Includes lab facilities, computers and instruments for rent

* Local companies strong in ceramics, other materials (especially as fine coatings), fabrics, forestry & related products.

B. Streamlining Joint Research

- Intellectual property (IP) office established within the industry-univ cooperation center
  - Functions as JAIST's TLO/TTO.
  - Also manages personnel & financial aspects of joint/collaborative research contracts.
  - Staff of 1
  - JAIST has applied for a patent on at least 1 invention (ceramic related)
    - now in process of licensing.



C. Student Internships

- Among the ~100 PhD students, joint research in company labs is common.
  - Broadens their research perspective.
- About 20 out of 300 masters students do internships each year.
  - Length and location vary
    - About half may be outside local region
  - Help in job matching

D. Business Administration (BA) & MOT Programs

- Most students in 40s from local businesses. They are Interested in:
  - R&D management, including:
    - Management of university collaborations
    - Management of IP

    (although most local companies not R&D intensive)
  - Use of software and related business-management tools.
  - How to deal with globalization

D (cont.) BA & MOT Programs can promote links between local companies and:

- Industry-university cooperation center
  - Including the IP center
- Student internship program
- Other local businesses
- Prefectural government
- Local banks and credit cooperatives
  - Some of which are government backed
- Out-of-region businesses

E. Startup formation & support

- JAIST has about 10 startups
  - In top 1/3rd of national universities
  - 1 IT, 2 devices, 2 materials, 4 biomed, 1 agric
- Government backed regional banks and credit institutions have been important sources of finance.
  - Continuation of a long (and probably successful) historical practice.

E (cont): Venture Business Laboratory (VBL) established under COE Program

- Currently focusing on new business opportunities in forestry and related industries/technologies
  - Especially renewable resources
  - 1 forestry researcher works closely with the VBL

F. Possible supplemental steps

1. Strengthen existing Industry-University Cooperation Center, IP Center, and Internship programs
2. Encourage guest lectures from industry researchers & craftsmen
3. Entrepreneurship training for faculty and students
   - Maybe develop as branches of BA/MOT programs

F. Possible supplemental steps (cont.)

4. Work with local lenders to
   (a) facilitate equity investments in startups
   (b) increase cooperation with outside venture capital
   (c) maybe establish a pool of investor/managers
5. Training and recruitment of managers for startups,
   (a) begin to build this into BA/MOT programs,
   (b) use links with financial institutions and other businesses

ご清聴ありがとうございます
Thank you for your attention!

Worlds of Knowledge and Democracy

Is Civil Society a Daughter of Knowledge?

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In a recent review in the ***New York Review of Books*** (November 18, 2004, p. 38), the molecular biologist Richard Lewontin maintains that "the knowledge required for political rationality, once available to the masses, is now in the possession of a specially educated elite, a situation that creates a series of tensions and contradictions in the operation of representative democracy." Lewontin's observations about the linkage between knowledge and democracy very well sum up the set of questions I want to raise in this lecture.

Although questions of the **unmediated rather than indirect** relations between knowledgeability and democracy are not a widely discussed set of issues in social science, a recent, hotly contested case from the United States to which I will briefly later shows that this issue is also a highly contentious *practical political issue* that is by no means settled.

However, if one extends one's perspective to what are mediated relations between knowledge, civil society and democratic regimes, one constantly encounters its tracks; for example, under the heading of cultural capital and political franchise, access to educational institutions and political interest, educational achievement and political participation, political convictions and occupational status, and so on. Yet, I will restrict my observations to the more or less **immediate** linkage between knowledgeability and democratic conduct.

I will begin with a rather broad set of questions and claims: As Max Horkheimer emphasized -- in contrast to Karl Marx -- justice or equity and freedom do not mutually support each other. Does this **also** apply to democracy and knowledge? Or is knowledge a democratizer? Is the progress of knowledge, especially rapid advances a burden on democracy, civil society and the capacity of the individual to assert her will? And if there is a contradiction between knowledge and democratic processes, is this a **new** development or is the advance of liberal democracies co-determined by the joint forces of knowledge and democratic political conduct enabling one to claim that civil society if not democracy is the daughter of knowledge?

Knowledge has not only a performative or doing function (=**power**) it also has distributive or holding function (=**property**) in modern societies. In this contribution, I shall focus on the latter.

Overview

The theme I would like to explore in this presentation concern the multiple linkages between civil society, governance, and democracy. I will place this general question into the context of whether the presence and the nature of these linkages are co-determined by a growing knowledgeability of modern actors -- stressing growing chances of reflexive cooperation in civil society organizations, social movements and perhaps a growing influence of larger segments of society on democratic regimes as the result of actor's improved knowledgeability.

However, my specific purpose has to be more modest. Access to and the command of knowledge is stratified. I will explore three of these barriers and hurdles of access to knowledge and ask: (1) Is it possible to reconcile expertise and civil society, (2) it is conceivable to reconcile civil society and knowledge as a private good and (3) how dear (expensive) should knowledge be and what is the appropriate role of the state in providing knowledge?

Each of the terms I just introduced in my brief overview is an essentrially **contested** concept. I will try to clarify next how **I plan** to use these concepts, especially the notion of knowledge.

The Terms

Knowledge may be defined as a ***capacity for action***. The use of the term ”knowledge” as a capacity for action is derived from Francis Bacon's famous observation that knowledge is power. Bacon suggests that knowledge derives its utility from its capacity to set something in motion.

I refer to ***civil society*** not in its traditional sense as political society or the state but as the arena of active citizens interposed between the state and the intimate forms of life.

The possession of knowledge enhances **agency**. At the heart of civil society is agency. Agency is the ability of citizens to set goals, develop commitments, pursue values – and succeed in realizing them. Valuing agency is at the heart of subsidiary or self-government.

In asking about the differential command of knowledge of actors in modern societies, I am exploring -- reformulating the issue of differential access to knowledge – as the question of mastering one’s own life with the aid of the resource knowledge.

Introduction

There are of course a large number of more or less rival hypotheses that refer to the reasons for the emergence and persistence of democratic regimes and the strength of civil societies within such social systems; for example, Francis Fukuyama explicates his thesis about the end of competing ideologies in the last century by stressing, "there are fundamental economic and political imperatives pushing history in one direction, towards greater democracy." But other scholars argue that democracies can take a hold in countries that are poor and that democracy therefore does not follow economic development. But as claims for the war in Iraq have shown, democracy is also expected to follow from the barrel of guns.

In contrast to these modern claims, John Stuart Mill, in ***The Spirit of the Age*** (1831), published after his return to England from France, affirms his conviction that the **intellectual accomplishments** of his own age make social progress inevitable. But progress in the improvement of social conditions is not, Mill argues, the outcome of an "increase in wisdom" or of the collective accomplishments of science. It is rather linked to a **general diffusion of knowledge**.

Mill's observations in the mid-nineteenth century, a period he regarded as an age of moral and political transition, and in particular his expectation that increased individual choice (and hence emancipation from "custom") will result from a broad diffusion of knowledge and education, strongly resonates with the notion of present-day society -- the social structure that is emerging as industrial society gives way -- as a **knowledge society**.

John Stuart Mill was a great admirer of the classic study of American Society by Alexis de Tocqueville; as a matter of fact, Mill wrote a review of ***Democracy in America*** (1835-40) that was published almost at the same time as his ***The Spirit of the Age***.

But there are decisive differences between between Mill and de Tocqueville in their judgment of democracy, especially of the role of knowledge of its citizens for and in democratic regimes.

De Tocqueville closes his observations about American society by observing that the educational attainment of its citizens is an influential force in the maintaining democracy in America. While Mills has considerable confidence in the independent capacity of enlightenment, education and knowledge and intellectual skills as the ***necessary*** condition for the strength of democratic regimes, for De Tocqueville knowledge is the ***sufficient*** condition for democracy.

From Mills assumption it follows that intellectuals and scientists play a significant political role in democracies; in the case of De Tocqueville, it is the ordinary citizen and his or her immediate political practice that strengthens democratic political systems. Without taking side abut the specifics of the dispute between de Tocquevielle and Mill, I generally concur with thewir genral observation about the importance social role of knowledge for democracy.

I therefore reject the microphysics of power as elaborated Foucault. As is well known, in his genealogical work, Foucault describes the one-sided shaping of the individual by scientific disciplines such as penology, psychoanalysis etc. and the enormous, micromanaged power of regimentation and measurement in major social institutions. The observations by Foucault are based on a view of knowledge that assign too power to knowledge or the agencies in which it is embedded. Foucault underestimates the malleability of knowledge, the extent to whoich knowledge is conytested and capacity of individuals and civil society organizations to deply knowledge in order to **resist**, **oppose** and **restrain** major social institions in society.

There are various societal restraints that affect the wide dissimination of knowledge in society and therefore hinder the effective role of knowledge for democracy. I will refer to three barriesr under the heading of the following questions: (1) it is possible to reconcile democracy and expertise, (2) it is possible to reconcile democracy and knowledge as property and (3) it is possible to reconcile democracy and the knowledge divide?

Reconciling democtacy and expertisec

Many observers are convinced that the gap between expertise, that is, powerful agencies that harbor expert knowledge and the knowledge of laypersons in modern societies have dramatically and irreversible widened. On the other hand, it is evident that the social deference, the unquestioned respect and the taken-for-granted authority based on knowledge of the major professions (teachers, doctors, lawyers) at least im modern Western society has declined since at least the 1960s. Nonetheless, there is still widespread support for the “scientistic” perspective of nature of knowledge claims, namely that knowledge is universal and universally useful. The acceptance of a scientistic conception probably enhances the power of those who are seen as representing authoritative scientific knowledge.

Yet, the rising tempo with which knowledge is added has the opposite effect, instead of enhancing the universality of knowledge, a massive cleavage between those who directly participate in the process of knowledge production and those who are not part of the same process can be noted. The same observers therefore argue for the presence of a deficit model among different publics and stress the serious consequences the asymmetry between expert knowledge and the public has for the nature of civil society.

I will describe the deficit model in somewhat greater detail: The ease with which one delegates, of course aside from one's own specialty, judgment to the expert is seen to have hardened in all social institutions in modern society, not only in science. At the same time, it is widely assumed, for example, in the field of the "public understanding of science" that scientific illiteracy decreases the public's democratic capacities.

As a result, the "loss of contact" between science and the public emerges as one of the salient attribute of the interrelation between specialized knowledge and society. Large segments of the public have become disenfranchised and disabled from effective involvement in democratic processes that increasingly require a certain level of scientific literacy. This loss of contact is not only the result of a growing cognitive distance between science and everyday knowledge; it is also affected by the ever increasing speed of knowledge expansion based on a growing division of labor in science and by the deployment of knowledge as a productive capacity. The **decreasing** cognitive proximity increases the political distance from science, for example by restricting public reflection on both anticipated and unanticipated transformations of social and cultural realities resulting from the application of new knowledge. The scientific community shares responsibility for this diminishing intellectual proximity, since the preferred self-image of science as a consensual, even monolithic and monologic, enterprise is increasingly in conflict with both its public role and its own internal struggles about research priorities, as well as the generation of data and their interpretation.

However, on political and moral grounds many groups, constituencies and institutions must be consulted before decisions are made about issues that affect the regulation of knowledge and indirectly the development of science and technology. It would be misleading to think that the distance from and the loss of contact with science, or the considerable scientific illiteracy in modern societies, is somehow a 'potentially fatal flaw in the self-conception of the people today' (as Gerald Holton suggests) and/or signals the possibility of a dramatic collapse in public support for science.

It is more accurate to speak of a state of precarious balance affecting the autonomy and dependence of science in modern society. A loss of close intellectual contact between science and the public is perfectly compatible with both a diffuse support for science in modern society and an assent to legal and political efforts to control the impact of science and technology. In another sense, however, the loss of cognitive contact is almost irrelevant, and highly controversial; for example, when 'contact' is meant to refer to **close cognitive proximity** as a prerequisite of public participation in decisions affecting scientific and technological knowledge. Such a claim is practically meaningless because it almost requires public engagement in science-in-progress.

In arriving at judgment about expertise and civil society, one needs to take specific contexts into account The conditions under which different publics may make sense of specialized knowledge vary considerably. Rather than treating the relations between expertise and the public as a series of relations that involve individual, isolated actors, we need to think of the interaction between expertise and the public as mediated by cultural identities and the resourcefulness of civil society organizations reconstructing science and technology in distinct ways.

Moreover, without some element of trust exhibited by ordinary members towards experts, expertise would vanish. Nonetheless, experts today are constantly involved in a remarkable number of controversies. The growing policy field of setting limits to the presence of certain ingredients in foodstuffs, of safety regulations, risk management and the control of hazards has had the side effect of ruining the reputation of experts. As long as an issue remains a contested matter, especially a publicly contentious matter, the power and influence of experts and counter-experts is limited; once a decision has been made and a question settled, the authority of experts becomes almost uncontested as well. The work required to transform a contested matter into an uncontested issue is linked to the ability of experts to mobilize social and cultural resources in ***relevant*** contexts.

From the point of view of the scientific community, the lack of cognitive proximity to the general public has advantages and disadvantages. The loss of contact between science and the public can perhaps explain, at least in part, why the scientific community, in view of its attractiveness and usefulness for corporations, the military and the state, has been able to preserve a considerable degree of intellectual autonomy. Such autonomy, however, is contingent on a host of factors within and without the scientific community. The loss of contact is a resource for the scientific community. It signals a symbolic detachment and independence that can be translated into an asset vis-à-vis the state and other societal agencies. Science becomes an authoritative voice in policy matters; or it represents, in ideological and material struggles with other political systems, the openness of society. But the cognitive distance also limits the immediate effectiveness of the “voice of science” in civil society organizations as well as in policy matters, and extensive autonomy and independence of science may result in an excessive celebration of “normal” scientific activity and lead to a lack of innovativeness.

Reconciling democracy and knowledge as property

In testimony before the U.S. Congress more than a century ago, John Powell, a pioneer in the field of the earth sciences, put his finger on one of the most intriguing features of knowledge, namely “the possession of property is exclusive; possession of knowledge is not exclusive”. In spite of Powell’s thesis, some forms of knowledge are exclusive and become private goods as the result of legal restraints such as patents or copyright restriction attached to knowledge.

Whether knowledge is treated as a public or private good has many noteworthy consequences; for example, it is most likely incremental or new knowledge that is protected. In the context of economic systems but also science, this raises a serious dilemma: The basis of the growth of knowledge is knowledge. If knowledge is protected the growth of knowledge is hampered. But if knowledge is not protected, economist will argue, the incentive to invest in new knowledge disappears; monopoly rights are essential for the growth of knowledge and inventions.

In contrast to incremental knowledge, the general mundane and routinized stock of knowledge consists mostly of knowledge that is non-rival as well as non-excludable, that is, these forms of knowledge may very well constitute public goods.

Scientific knowledge constitutes one of the most important conditions for the possibility of modernization in the sense of a persistent extension and enlargement of social and economic action that science and not any social system in modern society generates.

I do not want to discuss the contentious issue of trade-offs that may exist between assigning proprietary rights to knowledge and the gains in the overall welfare of society or the trade-offs between treating knowledge as a public good and the loss of welfare for those that cannot reap the benefits from their inventions and discoveries.

Economists, legal scholars and major international organizations such as the World Bank make the case that knowledge must be a (global) public asset. From an economic viewpoint this means that knowledge should lack the characteristics, otherwise typical for economic assets, namely rivalry and excludability. That some forms of knowledge are public goods **is least likely** the case for additional, that is, new knowledge. And it is additional knowledge that turns a profit.

Thus, the age-old dilemma whether property generates power and thereby fashions human relations or whether it is the other way around continues to be played out even in knowledge societies.

Reconciling democracy and the knowledge divide?

For almost a decade, the State of New York and the City of New York are embroiled in a legal battle over whether the state is paying its fair share toward New York City’s public school system. The contested issue is less about money although in the end it also is about money, it is about the minimal obligation governments have to educate its children. The dispute revolves around the intriguing question what exactly is meant by the constitutional promise of a "sound, basic education" for the children in the state.

The very first sentence in the June 2003 decision of the appeals court affirms, "we begin (our ruling) with a unanimous recognition of the importance of education in our democracy. The fundamental value of education is embedded in the Education Article of the New York State constitution by this simple sentence: "The legislature shall provide for the maintenance and support of a system of free common schools, wherein all the children of this state may be educated."

The plaintiffs of course contend that the State fails to afford New York City's public schoolchildren the educational opportunity guaranteed by the constitution. But what exactly is the constitutional human right to education, what is a sound basic education? State schools, a previous court ruling suggested, are "obligated by the state Constitution to do nothing more than prepare students for low-level-jobs, for serving on a jury and for reading campaign literature, that is the equivalent of an eighth- or ninth-grade education. And in this respect, New York City, however troubled its schools, met that standard, however limited that standard. The court decision did not please the plaintiffs and they appealed. A subsequent 2003 decision of the Court of Appeals held that as one judge put it, "a high school education is now all but indispensable."

The lengthy New York court cases were mainly about state responsibilities toward the ***collectivity*** of children, it does not address its responsibility toward individual pupils, especially in as much as such responsibilities may arise from what I would call the "knowledge divide." Thus, in stark contrast to the ruling of the New York Appeal Court, courts in other US jurisdictions have tackled the "knowledge divide". The New Jersey Supreme Court for example takes the view that state schools should be responsible for remedying educational deficits that might have their roots in larger problems, such as social inequality, ethnic or family backgrounds.

Public policies that follow from these different approaches are significant. In the latter case, redistribution of property-tax is in order and affirmative actions programs are justified while in the case of the former approach enormous inequalities in outcome of schooling standards are acceptable.

Concluding remarks

My presentation concentrated on questions concerned with how to gain knowledge in modern society and less on what to do with it. That is the topic of another lecture. The basic claim for the moment however is that democratization in modern societies as knowledge societies increasingly extend to the *democratization and negotiation of knowledge claims*.

I assume that scientific knowledge is much more malleable and accessible than is suggested in the classical perspective of the relations between science and society. The new sociology of scientific knowledge has familiarized us with the perspective that the production of scientific knowledge is in many ways very similar to other social practices. The boundaries between expertise and everyday knowledge are much less fixed and robust than is often surmised, especially in observations that lament about a growing distance between expert knowledge and the public's knowledge. Knowledgeability has social externationalities through the production a more participatory democracy or citizenship from which civil society organizations benefit most.

This produces particular challenges, for example, in terms of access to knowledge but also in the form of new modes of participation. And here civil society organizations will be challenged.

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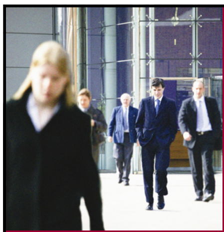
Reflections on Knowledge Management from a Critical Systems Perspective

Professor Mike C. Jackson
Hull University Business School

JAISTᅟ
10 November, 2006



KM and Critical Systems Thinking

Have in common:

- applied management transdisciplines
- concerned with individual and organisational learning
- use similar concepts

Strengths of CST :

- theoretical awareness
- methodological sophistication

Strengths of KM

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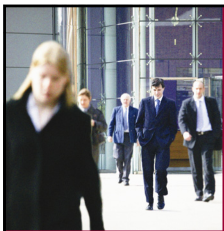
Theoretical Awareness I

- the machine metaphor
- the organism metaphor
- the social-systemic metaphor
- the coercive system metaphor
- the carnival metaphor



Theoretical Awareness II

- KM and the machine metaphor (Western tradition, explicit knowledge, problems)
- KM and the organismic metaphor (Japanese tradition?, tacit knowledge problems)
- KM and the social-systemic metaphor (KM dynamics and dialectics)
- KM and the coercive system metaphor
- KM and the carnival metaphor

A pluralism of models/metaphors?

Theoretical Awareness III

Advantages:

- clarity about theoretical assumptions
- strengths and weaknesses of different approaches better understood
- promotes learning
- a pluralist approach to intervention
- further enriching of the field
- disciplinary partnership

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Methodological Sophistication I

Practical KM recommendations

- SECI, the knowledge-creating spiral
- Knowledge enabling characteristics
- ba
- dialectics

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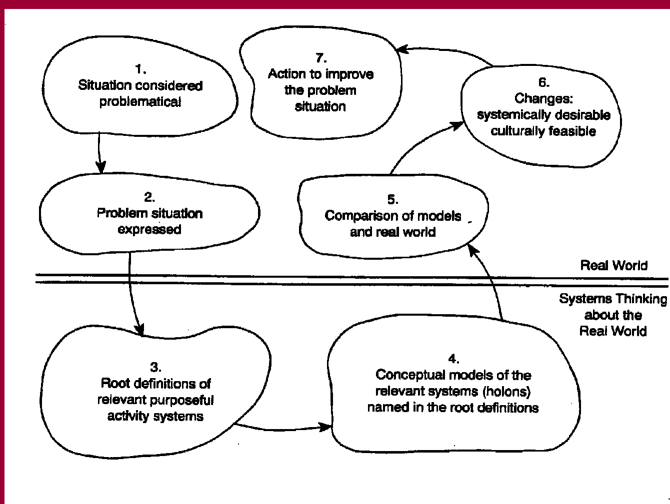
Methodological Sophistication II

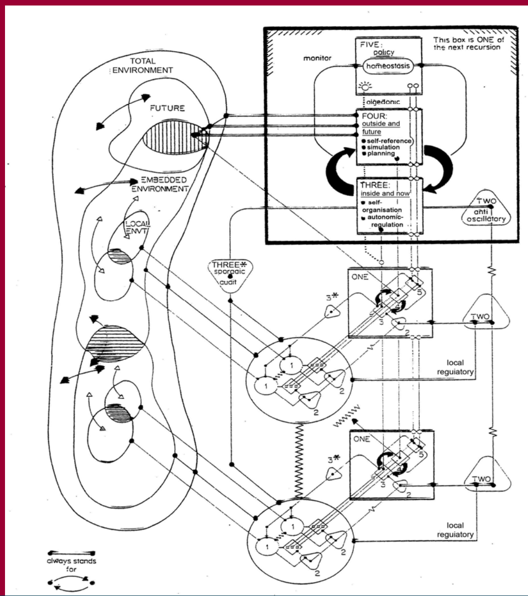
- SECI - soft systems methodology
- Knowledge enabling characteristics
  - idealized design
  - viable system model
  - complexity theory
- ba - team syntegrity
- dialectics - dialectical debate

[soft systems thinking and tacit knowledge]

The Learning Cycle of Soft Systems Methodology (after Checkland, 1989)



The Viable System



Conclusions

- Compatibility of KM and CST traditions
- CST helping KM
  - theoretical awareness
  - methodological sophistication
- KM helping CST
- The need for an extended dialectical debate between KM and CST

The Knowledge-Creating Company:
Strategy, Ba, Leadership

Strategy-as-Distributed Phronesis

Ikujiro Nonaka

Professor, The Graduate School of International Corporate Strategy

Hitotsubashi University

Xerox Distinguished Faculty Scholar

UC Berkeley

Why Do Firms Differ ?

Positioning Theory: Mobility barriers
RBV: The cost of acquiring resources
Evolutionary Economics: Managers' limited capability to foresee the future.

Problems in the rationalist approach to strategic management:

1. Overlooking the aspect of strategy as practice in a particular context
2. Emphasis on objective analysis overlooks the subjective aspect of strategy
3. Emphasis on analysis of the past misses the fact that strategy is a process of creating the future.

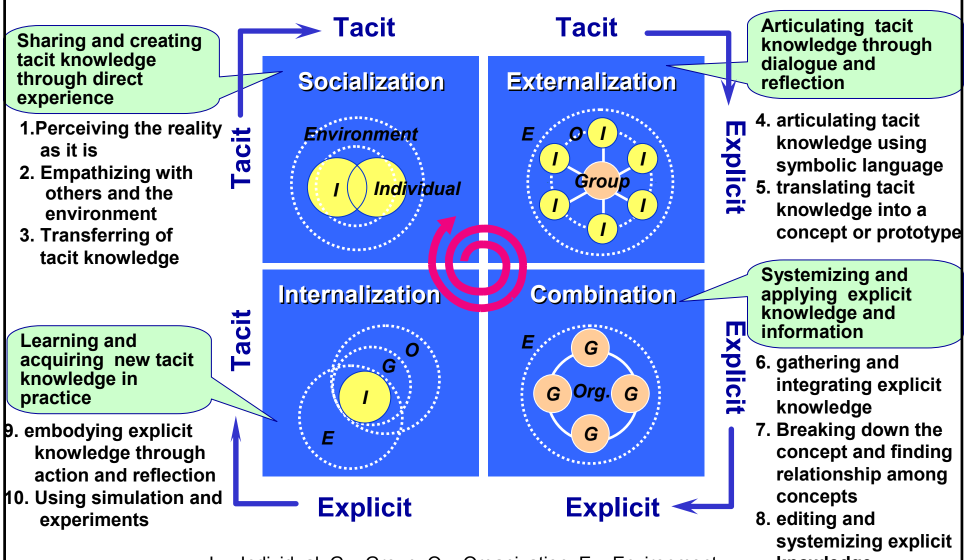
Why Do Firms Differ ?

Because

Firms/Organizations *Envision*

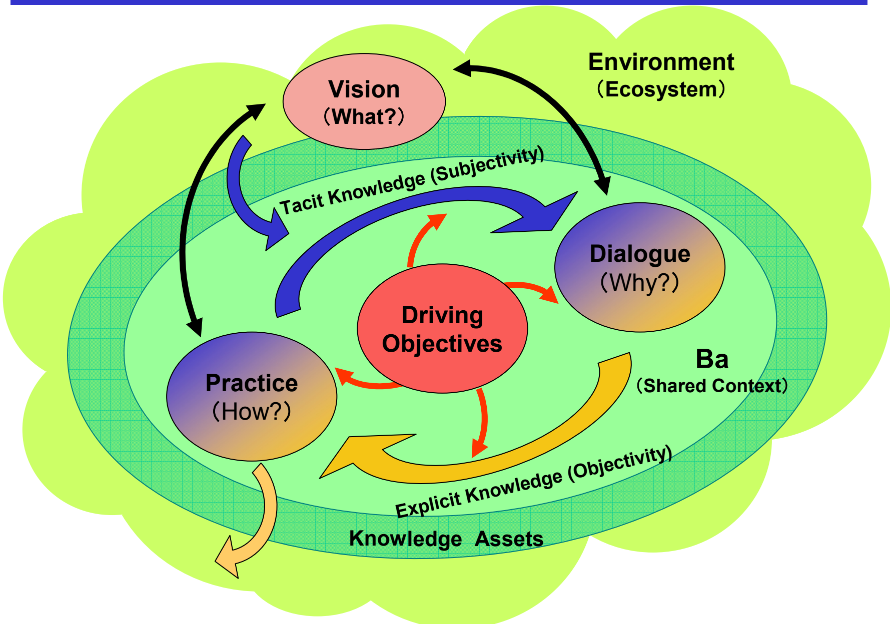
Different Futures and Realize Dreams.

SECI Process



I = Individual, G = Group, O = Organization, E = Environment

Basic Components of Knowledge-creating Firm



Leadership in Knowledge-Creating Company

It is a dynamic process of synthesizing the vision, ba, dialogue, practice, knowledge assets, and the ecosystem of knowledge to create knowledge.

At the basis of such leadership is **phronesis.**

Aristotle's Three Types of Knowledge

- •Episteme (Scientific Knowledge)
  Universal, context-free and objective knowledge (explicit knowledge)
- •Techne (Skills and Crafts Knowledge)
  Practical and context-specific technical know-how (tacit knowledge)
- •Phronesis (Practical Wisdom)
  Experiential knowledge to make context-specific decisions based on one's own value/ethics (high quality tacit knowledge)

Phronesis (Prudence, Practical Wisdom)

A virtuous habit of making decisions and taking actions that serve the common good.

A capability to find a "right answer" in particular context.

Deliberate reasoning and improvisation that comes from the SECI process, which synthesizes particulars and universals.

Can acquire only through high quality direct experiences.

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Six Abilities that Constitute Phronesis

Ability
- to make a judgement on goodness.
- to share contexts with others to create ba/shared sense.
- to grasp the essence of particular situations/things.
- to reconstruct the particulars into universals using language/concepts/narratives.
- to use any necessary means well to realize concepts for common goodness.
- to foster phronesis in others to build resilient organization.

Phronetic Leadership ①

Ability to make a judgement on goodness.

Seeking Good

Every sort of expert knowledge and every inquiry, and similarly every action and undertaking, seems to seek some good. Because of that, people are right to affirm that the good is 'that which all things seek'.

(Aristotle, Nicomachean Ethics)

Why do we create knowledge?: A story of Honda

Honda was trying to develop the CVCC engine, which had lower emission and higher fuel efficiency. Souichiro Honda, the founder and then CEO of Honda one day told his engineers that the engine would finally give Honda the opportunity to beat Big 3.

The engineers looked at Mr. Honda, and said, "Please, don't say such a thing. We are not doing this to beat other guys. We are doing this for our children."

Mr. Honda was ashamed of himself, and said that he realized that he had become too old, and decided to retire.

Phronetic Leadership ②

Ability to share contexts with others to create ba/shared sense.

Reading the Situation and Grasping the Opportunity

“Joking is very difficult. You have to grasp the atmosphere of the occasion and the opportunity. It exists only for that particular moment, and not anywhere else. The joke is in the timing and it doesn’t work at any other moment…. To joke is to understand human emotion.”

Souichiro Honda

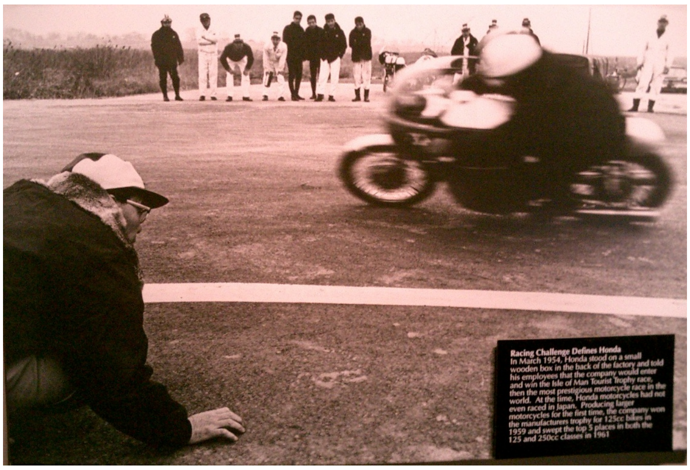
Ba: Asakai (Morning Meeting)

Phronetic Leadership ③

Ability to grasp the essence of particular situations/things.

God is in detail

Indwelling in a Particular Situation



Phronetic Experience

"I can see many things when I see a machine. How can we maneuver through that curve? We should do this, we should do that.... Then I think about the next machine. We can make a faster machine if we think like this, and so on. It's a natural progress into the next step."

Phronetic Leadership ④

Ability to reconstruct the particulars into universals using language/concepts/narratives.

Concept Building: Dialoguing on the Spot

Need for Universal Theory

"Action without philosophy is a lethal weapon; philosophy without action is meaningless."

"Just to be hard working has no value. Rather, working hard in the wrong way is worse than laziness. 'The right theory' is the necessary premise for working hard."

Souichiro Honda

In Touch with the Reality: Mitarai Visiting the Factory

Phronetic Leadership ⑤

Ability to use any necessary means well to realize concepts for common goodness.

Making Political Judgment

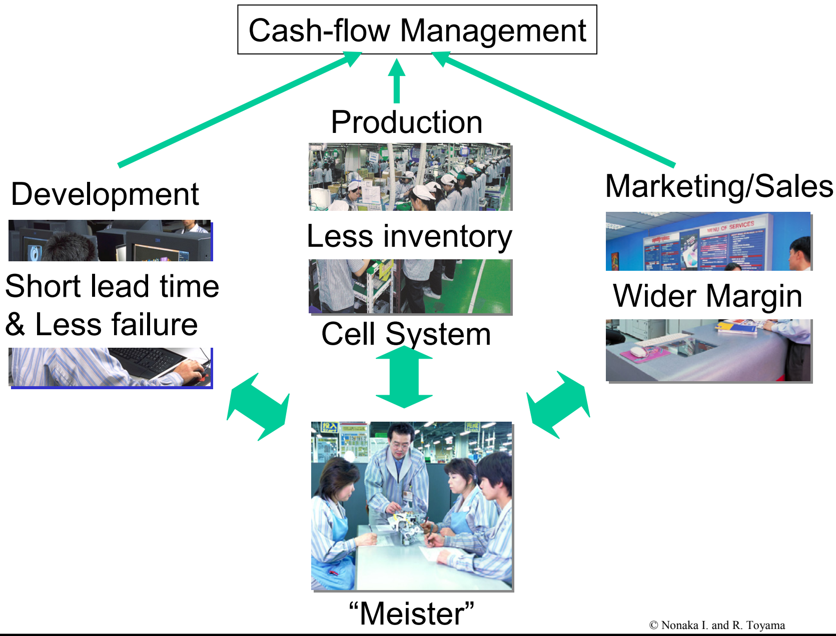
The reality of the strategic process is dynamic and full of confusion and contradiction. In a knowledge-creating organization, rather than seeking an optimal balance between contradictions, they are synthesized in dialectical thinking through social interactions. Such process is political, driven by the ability to make political judgments. Phronetic leaders exercise political judgment by understanding others' emotions, and by giving careful consideration to the timing of their interaction with others.

Canon as a Dialectic Company

"Paradox is a way of life at Canon….Facing a paradox, we embrace it and go ahead coping with it. We are constantly on the move."

-- Fujio Mitarai, President and CEO

Canon's Driving Objectives



Phronetic Leadership ⑥

Ability to foster phronesis in others to build resilient organization.

Fostering Phronesis

To make phronesis a distributed phenomenon, one has to present the issues to be worked out, to constantly ask the question 'what is the good,' and provide examples in each situation that can teach the phronetic way of thinking in practice. It is an ability to enable people to understand what phronesis is through practice, and it is taught through face-to-face interaction.

Honda's Fundamental Beliefs

The "Three Joys":

The joy of buying, the joy of selling and the joy of creating

Fundamental Disciplines

GE

- What does your global competitive environment look like?
- In the last three years, what have your competitors done?
- In the same period, what have you done to them?
- How might they attack you in the future?
- What are your plans to leapfrog over them?

Toyota

- Set even higher goals and implement continuous improvements without settling with temporary success.
- Observe the place of manufacturing with a clean slate and without bias, repeat 'why?' five times to the subject.
- Understand one's own capability through comparison internally and externally.

Honda

- 3-Gism: Be at the actual place of work (genba), know the actual product (genbutsu) and situation (genjyou), be realistic (genjitsuteki).
- Respect sound theory, develop fresh ideas and make the most effective use of them.
- A00 -What do you do this for? (Ontological)
- A0 - What is your concept? (Conceptual)
- A - What is your specification? (Operational)

Strategy as Distributed Phronesis: A Case of Seven-Eleven Japan

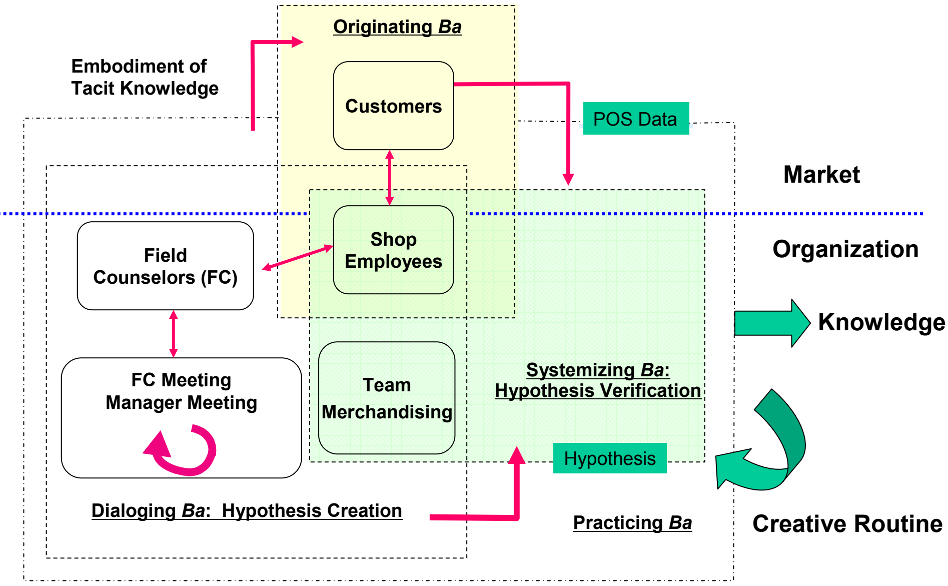
（audio-visual media）

Judging what is Good

Our competitors are neither other companies nor other stores, but our customers' needs and wants. Our absolute value is to answer the fundamental questions of “what does the customer want?”

-Toshifumi Suzuki, CEO, Seven-Eleven Japan

Systemizing, Multi-layered Ba at 7-11 Japan



See Reality in Dynamic Context

It is impossible to apply universal rules derived from past experiences, since customers’ need keeps changing and each store is operating in different context. We are successful only by denying the past and constantly reflecting on the future to find fundamental solutions in each particular context.

-Toshifumi Suzuki, CEO, Seven-Eleven Japan

Hypothesis Building

The concept of opportunity loss from unrealized sales is invisible and difficult to grasp since it is buried In tacit insights gained in particular context for each store. Rather than written manuals, each employee is requested to think and act on his/her subjective insights into the local market accumulated through daily face-to-face interactions with customers.

Such subjective insights in particular contexts are objectified through the process of hypothesis building and testing. It is not good if you just see a tree, not a forest. Of course you have to see the particular tree. But you have see to the entire forest as well as the trees.

-Toshifumi Suzuki, CEO, Seven-Eleven Japan

Developing Distributed Leadership

I only have two eyes. There are several ten thousands part-time works at Seven-Eleven Japan stores. If everyone can make a judgment on his/her own, we have quite a few eyes. To do so, everyone of us have to respect the fundamental rules of business.

No one knows for sure how the society will change in future. Because we don't know, we keep tackling the difficult task to adapt to changes. Everyday, I say that the most important thing is to adapt to any changes.

-Toshifumi Suzuki, CEO, Seven-Eleven Japan

A Knowledge-Based Firm is…

A company who practices the idealistic pragmatism which synthesizes;

Ontology: How to be

-"For what do we live?": the vision to the future and the commitment to it.

Epistemology: How to know

-"What is the truth?": the SECI spiral which synthesizes objective and subjective views.

Creation: How one can change itself and the environment

Management is viewed as "a way of life" rather than a tool to make money.