Systems Sciences Toward the New Liberal Arts for the Global Society of 21st Century

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Problems of Systems Sciences
A little influence of Systems Sciences

• Nowadays Systems Sciences have a little theoretical and methodological influence and ability for connecting the wide area of modern sciences and humanities.

• The original purpose of the Society of General Systems Research was "to encourage the development of theoretical systems which are applicable to more than one of the traditional departments of knowledge."
Original Mission of SGSR

- The initial purpose of the society was "to encourage the development of theoretical systems which are applicable to more than one of the traditional departments of knowledge," with the following principal aims:

  - to investigate the isomorphy of concepts, laws, and models in various fields, and to help in useful transfers from one field to another;
  - to encourage the development of adequate theoretical models in areas which lack them;
  - to eliminate the duplication of theoretical efforts in different fields; and
  - to promote the unity of science through improving the communication among specialists.
Thin Diffusion of Systems Concepts

• Now the concept of system becomes very popular and some systemic concepts such as feedback are used as common knowledge in our life world.

• On the other hand there is a few connection between ISSS and new development of systems research such as CAS (Complex Adaptive Systems), Agent Based Modeling or SSME (Service Science, Management and Engineering).
Defect of Traditional Systems Research

• Traditional systems research and the society could not take the initiative in the emerging new research fields that are strongly connected to targeted domain of new systems research such as emergent properties, evolution, learning, self-organization and bottom up approach.

• They focus on bottom up approach in the emerging new systems area such as CAS and ABM.
Systems Methodology and Philosophy of Sciences
Philosophy of Sciences for Artificial

- From methodological points of view the traditional systems research and the society have weak relationship to modern philosophy of sciences and the matters of its academic concern.

- We also have not established the philosophy of science for artificial & social semantics.
We discuss the issues of social systems theory in comparison with a mathematical or general systems theory.

Social systems theory by N. Luhmann is characterized by theoretical treatment of macro communication process.

This treatment had started from the theory of representation collective by E. Durkheim. It is natural and reasonable research program from sociological point of view.

On the other hand it is a little bit strange way from standard semantics of analytic philosophy.
• In the history of analytic philosophy the meaning of proper name is given by referred object in the real world or at least by rigid designator.

• There is almost no connection between sociological treatment of representation collective and these analytic philosophical treatment.

• On the other hand there is a strong gap of research program between Luhmann’s social systems theory and general or mathematical systems theory.

• The gap causes incommensurability between two research group about theoretical terms such as systems boundary, environment, micro-macro link, self reference, communication, complexity and autopoiesis.
• S.A. Kripke has argued that proper noun and natural kind are characterized by rigid designator. How the designator is shared in the society. The answer by Kripke is the usage of causal chain. Its too naive from social science point of view.

• On the other hand Quine has insisted that the foundation of epistemology is closely connected to natural sciences, especially cognitive sciences [Quine,1969]. (A kind of Spiral Approach)

• In any cases epistemological research programs can not be closed inside its research domain.
Classical Liberal Arts of Western World
Liberal Arts (from Britannica)

• College or university curriculum aimed at imparting general knowledge and developing general intellectual capacities, **in contrast to** a professional, vocational, or technical curriculum.

• **In Classical antiquity**, the term designated the **education proper to a freeman** (Latin liber, “free”) as opposed to a slave. In the medieval Western university, the seven liberal arts were grammar, rhetoric, and logic (the trivium) and geometry, arithmetic, music, and astronomy (the quadrivium).

• **In modern colleges and universities**, the liberal arts include the study of literature, languages, philosophy, history, mathematics, and science.

http://concise.britannica.com/ebc/article-9370154/liberal-arts
Classical Seven Liberal Arts

- Grammar
- Rhetoric
- Logic
- Arithmetic
- Geometry
- Music
- Astronomy
Classical Liberal Arts of Oriental World
Mo-tzu (墨子: Bokusi)

Mo Tzu (490-403 BC or 470-391 B.C.) was a philosopher, architect and engineer in the old China. Part of his philosophical idea was coming from architectural concepts.

He and his school came not from the upper-class but from the lower-class (slave class) people such as architect.

We say Mo-tzu and his school tried to constructed different version of “Liberal Arts” under the oriental context.
Mo-Ztu’s “Liberal Arts”

• Ethics: 兼愛: Sympathy (Some time translated to “universal love” but its wrong. It is similar to Adam Smith’s concept of Sympathy (The theory of moral sentiments) => Gaming Simulation!

• Peace Keeping: 非攻 Attacks against war! He used social (gaming) simulation for peace keeping & risk communication for the first time in the world.

• Activities of his school include Logic, Rhetoric, Optics, Ethics, Peace Keeping and Political Practice depending on their practical ethics. (No Music)

• His mission and interdisciplinary background (philosopher, engineer and pragmatic social architect) are similar to ours.
First Social Simulation in the world wad done by Mo-tzu(墨子) in China around B.C. 400.

* Mo-tzu challenged 公輸盤( General of the army ) to simulation war. Mo-tzu took off his leather belt. His belt was supposed to be a castle. Small wooden tag was supposed to be a siege-ladder; weapon to attack a castle that was invented by 公輸盤.

* 公輸盤 attacked to the castle by using his new weapon nine times. But entirely Mo-tzu protected the castle. Thus the king had given up to attack the castle.

History of Social Simulation had started from Social Problem Solving (Peace Keeping)!! for becoming free from the misery by war.
公輸第五十

公輸盤為楚造雲梯之械，成，將以攻宋。子墨子聞之，起於齊，行十日十夜而至於郢，見公輸盤。公輸盤曰：「夫子何命焉為？」子墨子曰：「北方有侮臣，願藉子殺之。」公輸盤不說。子墨子曰：「請獻十金。」公輸盤曰：「吾義固不殺人。」子墨子起，再拜曰：「請說之。吾從北方，聞子為梯，將以攻宋。宋何罪之有？楚國有餘於地，而不足於民，殺所不足，而爭所有餘，不可謂智。宋無罪而攻之，不可謂仁。知而不爭，不可謂忠。爭而不得，不可謂強。義不殺少而殺眾，不可謂知類。」公輸盤服。子墨子曰：「然，乎不已乎？」公輸盤曰：「不可。吾既已言之王矣。」子墨子曰：「胡不見我於王？」公輸盤曰：「諾」。

子墨子見王，曰：「今有人於此，舍其文軒，鄰有敝廬，而欲竊之；舍其錦繡，鄰有短褐，而欲竊之；舍其粱肉，鄰有糠糟，而欲竊之。此為何若人？」王曰：「必為竊疾矣。」子墨子曰：「荊之地，方五千里，宋之地，方五百里，此猶文軒之與敝廬也；荊有雲夢，犀兕麋鹿滿之，江漢之魚鱉鼋鼍為天下富，宋所為無雉兔狐狸者也，此猶粱肉之與糠糟也；荊有長松，文梓，楩柟，豫章，宋無長木，此猶錦繡之與短褐也。臣以三事之攻宋也，為與此同類，臣見大王之必傷義而不得。」王曰：「善哉！雖然，公輸盤為我為雲梯，必取宋。」

於是見公輸盤，子墨子解帶為城，以牒為械，公輸盤九設攻城之機變，子墨子九距之，公輸盤之攻械盡，子墨子之守圉有餘。公輸盤诎，而曰：「吾知所以距子矣，吾不言。」子墨子亦曰：「吾知子之所以距我，吾不言。」楚王問其故，子墨子曰：「公輸子之意，不過欲殺臣。殺臣，宋莫能守，可攻也。然臣之弟子禽滑釐等三百人，已持臣守圉之器，在宋城上而待楚寇矣。雖殺臣，不能絕也。」楚王曰：「善哉！吾請無攻宋矣。」

子墨子歸，過宋，天雨，庇其閭中，守閭者不內也。故曰：「治於神者，眾人不知其功，爭於明者，眾人知之。」
Free from what?

New Liberal Arts for Autonomous Individuals
Serve for what & Free from what?

• Classical liberal arts have the mission to serve God and man and to become free from all others except God in the context of pre modern society.

• In the modern educational school the idea of liberal arts has outlived its usefulness.

• We need new “Systems Liberal Arts” for Autonomous individuals free from embedded life world, society and Nation State.
From Nation State Embedded Modern Society to Where?

What are the Life World Platforms of 21 Century?
How to avoid cultural and language lock-in.

Modern Functional Differentiated World
Now we are living inside partly embedded & partly disembedded society.

We face Semantic differentiation = Cultural cross platform

To be embedded, or to not to be embedded? That is the question.
Liberal Arts for What?

• We need the new liberal arts for the global society, in order to become free from all things including Gods and Nation States, if it cause misery and unhappiness to our life world.

• The new liberal arts do not serve 'God and man' but serve human beings under the cross cultural context of our global societies with or without Gods.

• New global liberal arts should serve not for the liberty under the God but for the liberty under the cross cultural, trans-states and trans-civilization context.
Ability of drawing intellectual Map (Internal Model) for individuals free from embedded worlds
We require the ability of drawing intellectual Map(IM) for individuals free from embedded worlds.

- We focus on how and why systems sciences can and should contribute to the creation of the new liberal arts program for designing new century's socioeconomic and life-world systems.

- The construction of the systems sciences as new liberal arts is not as same as the traditional construction of liberal arts.

- The new liberal arts should support the ability of drawing intellectual map of knowledge. Only the systems science can answer the request.
We strongly require the intellectual map or the frame of reference for recognizing, understanding and designing the systems of the complex global society and the related life world in this century, for redesigning its functional and semantic systems from economical, political, sociological, organizational, cultural and service oriented points of view.
Other Systems Approach for New Liberal Arts
My Research Map

- **Mathematical Analysis**
- **Agent Based Simulation Language**
- **Social Architecture Design**
- **Program & Project Management**
- **Feed forward by Shared Internal Model & Feed back to the Model**
- **Japanese Contents Industry Analysis**
- **Social Learning Dynamics**
- **Exchange Algebra**
- **Tool**
- **Feed back to the Model**
- **Gaming Simulation & Hybrid Simulation**
- **SOARS Portable Grid**
- **Participatory Approach**
- **Cultural Platform and Lock- analysis**
- **Reconstruction of Information System of System of National Accounting**
- **Tool**
- **Support**
- **SOARS Spot Oriented Agent Role Simulator**
- **Application**
- **Simplifier**
- **Participation Approach**
- **Gaming Simulation & Hybrid Simulation**
- **Application**
- **Support**
- **Cultural Platform and Lock- analysis**
- **Anti Pandemic Simulation for Small pox terrorism & New Influenza**
- **Collaboration with Japanese Government**
- **Economic and Social Research Institute (ESRI), Cabinet Office, Government of Japan**
- **National Institute of Infectious Diseases**

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**Field Analysis**

**Conceptual & Methodological Approach**

**Social Learning Dynamics**

**Mathematical Analysis**

**Agent Based Simulation Language**

**Social Architecture Design**

**Program & Project Management**

**Feed forward by Shared Internal Model & Feed back to the Model**

**Japanese Contents Industry Analysis**

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**Exchange Algebra**

**Tool**

**Feed back to the Model**

**Gaming Simulation & Hybrid Simulation**

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Commensurability Gap
Commensurability Gap

- The importance of bridging the conceptual or commensurability gap among systemic properties used in different disciplines is becoming more important than the early stage of General Systems Research.

- Now the commensurability gaps among core systems disciplines are becoming more serious for drawing our intellectual map.

- There are two different types of commensurability gaps for systems properties.
Two Types of Commensurability Gaps

- The one is the gap between social systems theory and other systems theory.
  - For example, N. Luman gave the different meaning to the word of systems boundary from the standard usage of systems scientists.
- The other is the gap between emergent areas of systems theories such as CAS and ABM and traditional systems theory.
  - They stress on bottom up approach. The bottom up approach is the opposite approach to the traditional functional approach.
The Gap between Bottom Up approach and Functional Approach

Macro Structure

Bottom-Up Construction from Micro-Level

Functional Constraint by Macro-Level Boundary Condition

Interaction via Micro-Macro Link

Agent: Internal Model
Decision Rules
Learning & Communication
Inter-subjective and Participatory Construction of Knowledge

• These gaps becoming more serious under the rapid expansion of the complexity of our knowledge for the world.

• Especially in the area of social sciences and humanities, we needs the way of inter-subjective and participatory construction of knowledge for the world.
New Liberal Arts Domain
To overcome the Commensurability problems

• We need the language to overcome the commensurability problems for the same intended system described by different theories and different value systems.

• This should be the main topic of the new systems theory and discipline for the creation of new liberal arts.

• For the purpose we have to develop trans-disciplinary methodology, modeling languages and meta models for bridging the gaps.
10 New Liberal Arts Domain

• We have to provide the shared concepts, language and intellectual map to bridge the gap not only for academic disciplines but also systems practices in the real world as follows.

• 1) Mathematical theory of systems modeling that include mathematical analysis of systemic properties.

• The axiomatic characterization of systems description and logical analysis of inter-systems relation are also the important topics in this area.
Conflict Resolution & Participatory Approach

• 2) The language for conflict resolution and accommodation is also an important area for the systems analysis and practice in the contemporary world.

• 3) Systems modeling and practices of participatory approach to construct the shared knowledge inside organizations or societies.
Extension of rational decision making

4) Extension of rational decision making that include not only traditional purposeful systems analysis but also contemporary evolutionary and learning aspects of decision making.
Anticipatory systems theory and Internal Model are important and a continuing research area.

- Internal mode theory and its way of construction and sharing are very important both for participatory approach, scenario analysis and social semantics.

- An internal model shared in the society gives feed forward ability to the society and the feed back to the internal model itself means social learning process.
Integration of functional and bottom up approach

- Integration of functional and bottom up approach is also old and new issue for socioeconomic and organizational system.

- In contemporary societies the integration is becoming more important not only for theoretical research interests but also practical point of view.
Social semantics & SSEM

7) Social semantics and communication theory for inter-subjective construction of shared understanding are important and challenging area for systems sciences.

- Traditional systems sciences mainly have focused on functional aspects.

8) Systems sciences for cultural contents, service analysis and value creation are emerging research fields.

- Service Science, Management and Engineering (SSEM) is focusing on this area.
Agent based social simulation

9) Agent based social simulation is also important area for extending the ability of systems description.

- Systems dynamics provides the modeling and simulation framework from functional stock and flow points of view.
- We have to extend our systems description from bottom up point of view.
- We also have to explore the integration of functional and bottom up approaches via the social simulation (see www.soars.jp).
Agent-based Simulations of Organizational Designs and Industry Evolution

Mizuta-san (under Kuse-san, Hidaka-san) at TRL is working with Researchers at IBM Almaden to do agent-based simulations of organization on the BlueGene supercomputer. Researchers at Almaden have connected BlueGene to the WebFountain supercomputer that can analyze the enter web and more.

70.72 teraflops on 11/2004
183.5 teraflops on 3/2004
(Linpack benchmark)
SOARS Programming Environment

Visual Programming Environment

Simulation Engine

Animation and Analysis of Simulated Log

SOARS Portable Grid

Start from Launcher

Human Player

Input Web

Output

SOARS Side

Hybrid Gaming Design

Animation and Analysis of Simulated Log

Simulation Engine

Visual Programming Environment

SOARS Portable Grid

Start from Launcher

Human Player

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Output

SOARS Side

Hybrid Gaming Design
Social Architecture Design
By SOARS

Design of Institutional
and Organizational
Structure under Mutual
Consent with Simulated
Reality

Simulation not for Prediction but for
Communication, Sharing Internal
Model and Option Evaluation

Social Architecture Design AS IS

Social Architecture Design for Future
Informed consent model for brain operation of aneurysm by simulated reality

Collaboration with Dr. Nagata, Doctor of brain surgery, who operated my aneurysm

Compair option of imidiate surgerly operetion with postpone the operation
5 mm aneurysm has found and wait until 10mm then operation
Replica model of currency market

Tokyo currency market, the yen-dollar crossing rate

Intervention & its timing

シミュレーション3.1 実需の変動に対する介入

介入なし　介入あり（1回 800）　介入あり（3回 200×3）
Depopulation Process of Small Village (1000 agents)

Almost Impossible Scenario
10) Systems philosophy and methodology should be developed under the communication with traditional philosophy of sciences.

We have to take a step forward on the road to create new liberal arts to contribute for creating the global knowledge of this century.

Or the systems society might become something historical landmark.
We have to escape from the Sweet Sanctuary for Part-time Specialists

Thank You for Your Attention

http://www.absss.titech.ac.jp/en/

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