Action by All toward Sustainability

Hiroyuki Yoshikawa
Japan Foundation for United Nations University
National Institute of Advanced Industrial Science and Technology

United Nations University Global Seminar 7th Tohoku Session

Extensive Use of Scientific Methods for Observation of Environment in the Past

--- Case of Global Warming ---

Observation and Warning by Scientists

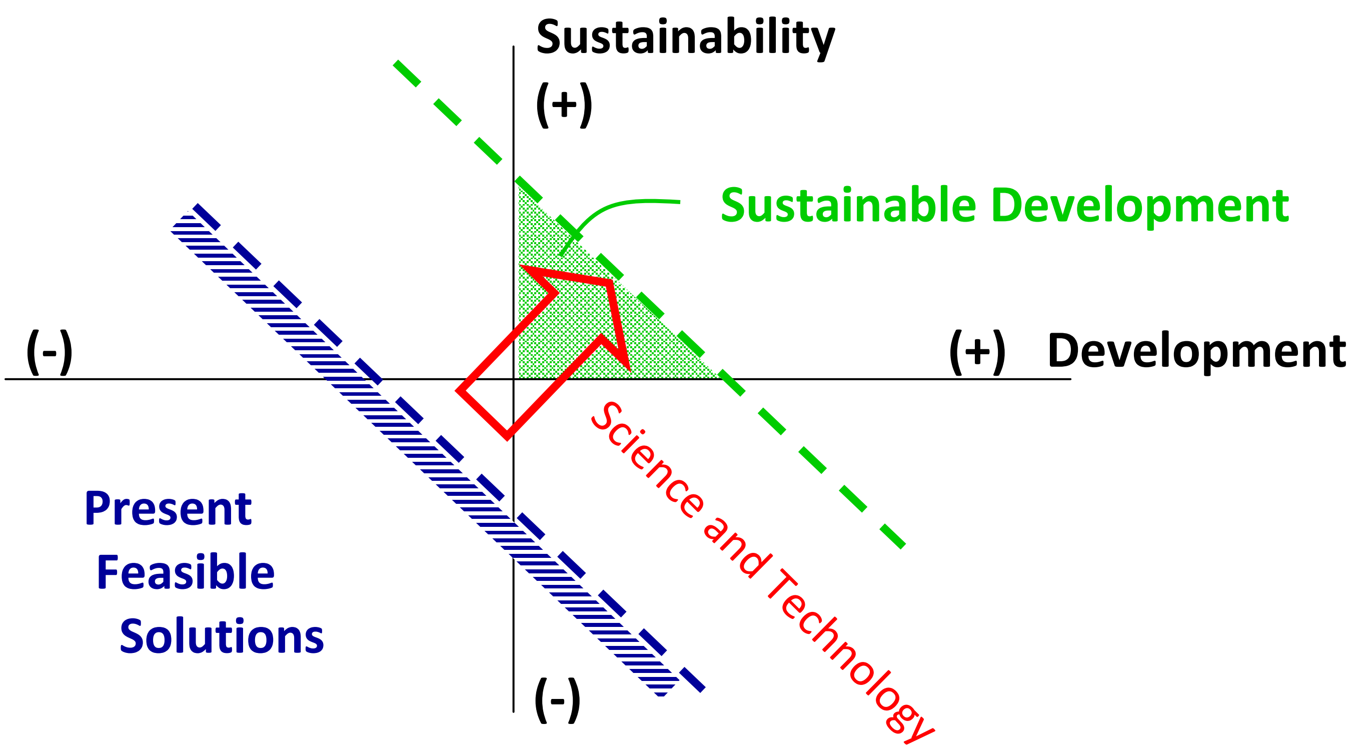
Global Warming

	1800	*(Scientists)*	
Observation		J. Fourier (1827)	"Greenhouse Effect"
	1850	J.Tyndall (1860)	Effect of air constituent to climate
	1900	S.Arrhenius (1896)	Calculation of CO_2/Temperature
Warning	1950	C. Keeling (1958)	Measurement of CO_2
		S. Manabe, R. Wetherald (1967)	Calculation of CO_2/Temperature
		J. Bruce (Villach Conf. ,1985)	Consensus of Scientists
	2000	G. Brundtland (UN Commission, '87)	Agenda 21
Action		*(?)*	Sustainable Action

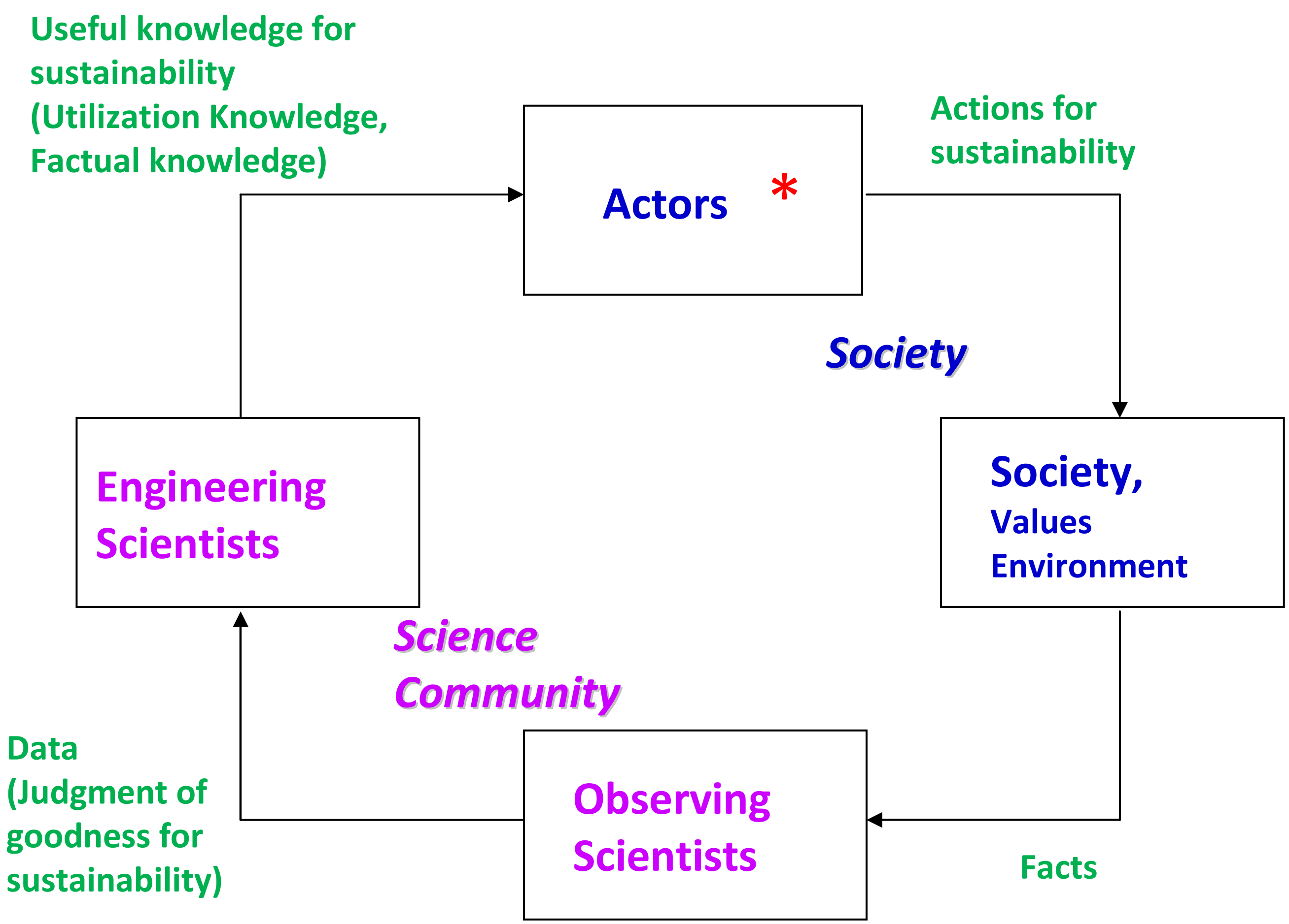
Sustainable Development

Sustainable Development by G.H.Brundtland (1987)

= (Sustain the earth) ^ (Develop Less-developed Regions)



Actions in Society: Information Cycle for Sustainable Evolution



*Actors in Society are:

statesmen,
policymakers,
business humans,
administrators,
engineers,
educators,
writers,
artists,
journalists,
etc...

who move society.

We must design evolutional loops in society for sustainability.

C. S. Peirce: Abduction, K. Popper: Piecemeal Engineering, F. Saussure: Evolutionary Loop

From Observation to Action

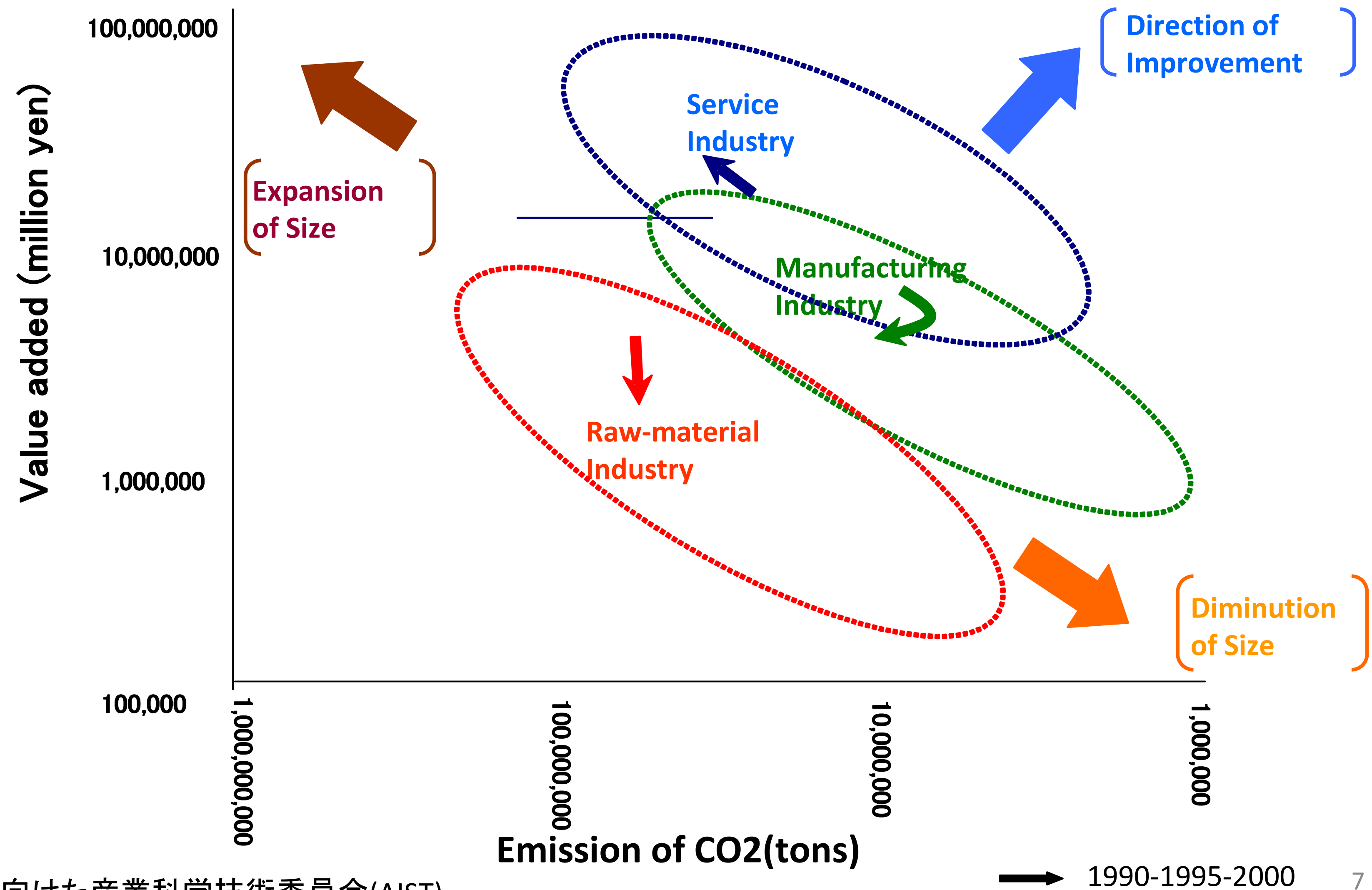
We have successfully observed changes of global environment by science and technology. Now, we should make more scientific and technological efforts toward actions to prevent the growth of and to protect us from the deterioration of sustainability.

Here, we shall discuss manufacturing industry, as an example, that is the most useful to develop less developed regions and, on the other hand, the most crucial to nfluence the global environment,

and try to find a way for society to realize sustainable development by industry.

Move of Centre of Gravity of Industries (Japan)

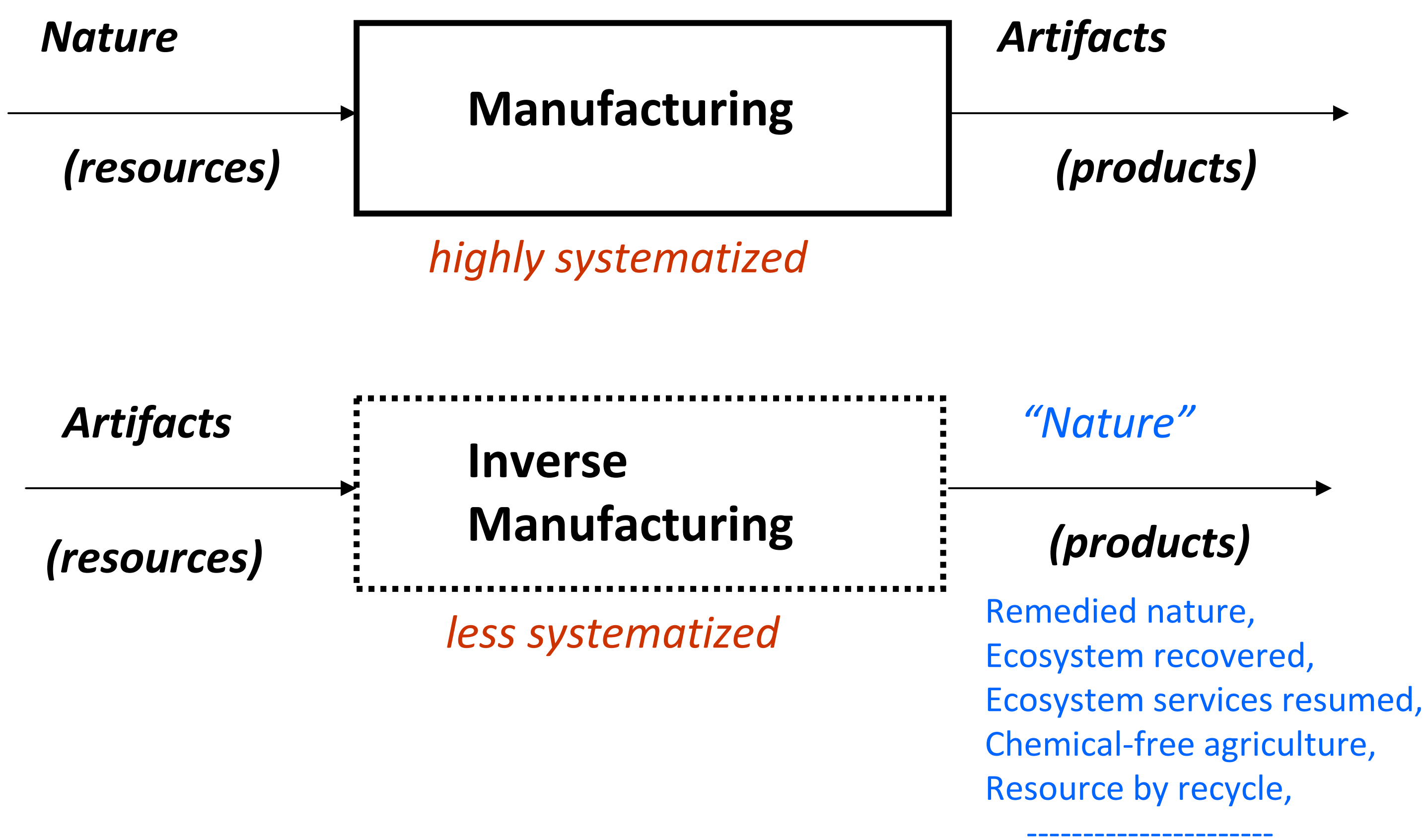
Preliminary Metrics by AIST



持続性に向けた産業科学技術委員会(AIST)

Inverse Manufacturing

(A manufacturing toward sustainability)



Practices of Manufacturing and Inverse Manufacturing

Manufacturing

- Mining,
- Reclamation,
- Construction,
- Cultivation and agriculture,
- Production of materials,
- Production of goods, etc

Inverse Manufacturing

- Forestation of desert,
- Fish planting,
- Recovery of contaminated lands,
- Biomass in devastated coast,
- Carbon sequestration,
- Bio decomposition of plastics,
- Waste processing,
- Maintenance, etc

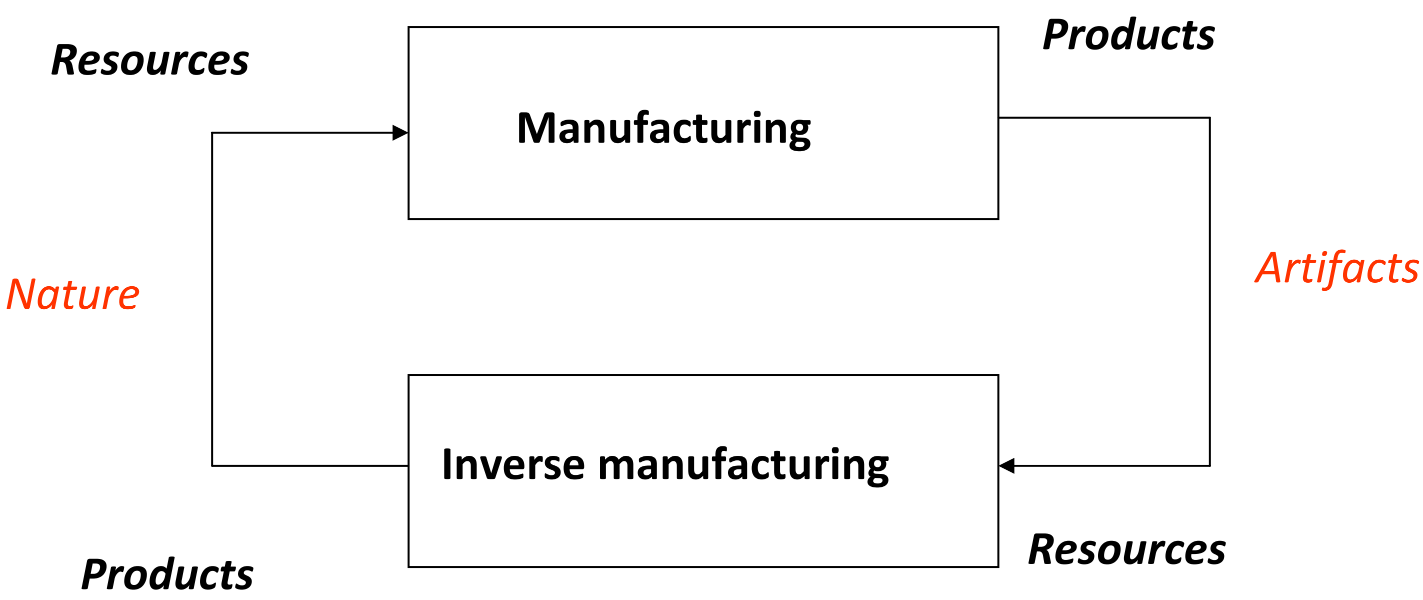
For sustainability, it is necessary to;

1. improve efficiency of either manufacturing,
2. keep good balance between both manufacturing, mutually dependent, for optimality, and
3. integrate manufacturing and inverse manufacturing toward a system.

METHODS : 1. STRUCTURE OF HUMAN ACTIONS
2. SUSTAINABILITY METRICS

Coupling of both Manufacturing

Closed- Loop Manufacturing



山家譲二(Jouji Yamaga)、還元工場論、工業技術、1975 より作図

Values of a Product

1. What people value is not a product itself, but its functionality.

2. Functionality of a product is service embedded in the product.

3. Latent functionality appears as service when the product is used.
   Use is physical interaction between specific part of the product and user.

   (People receive the service someone embedded in the product, when they use the product.)

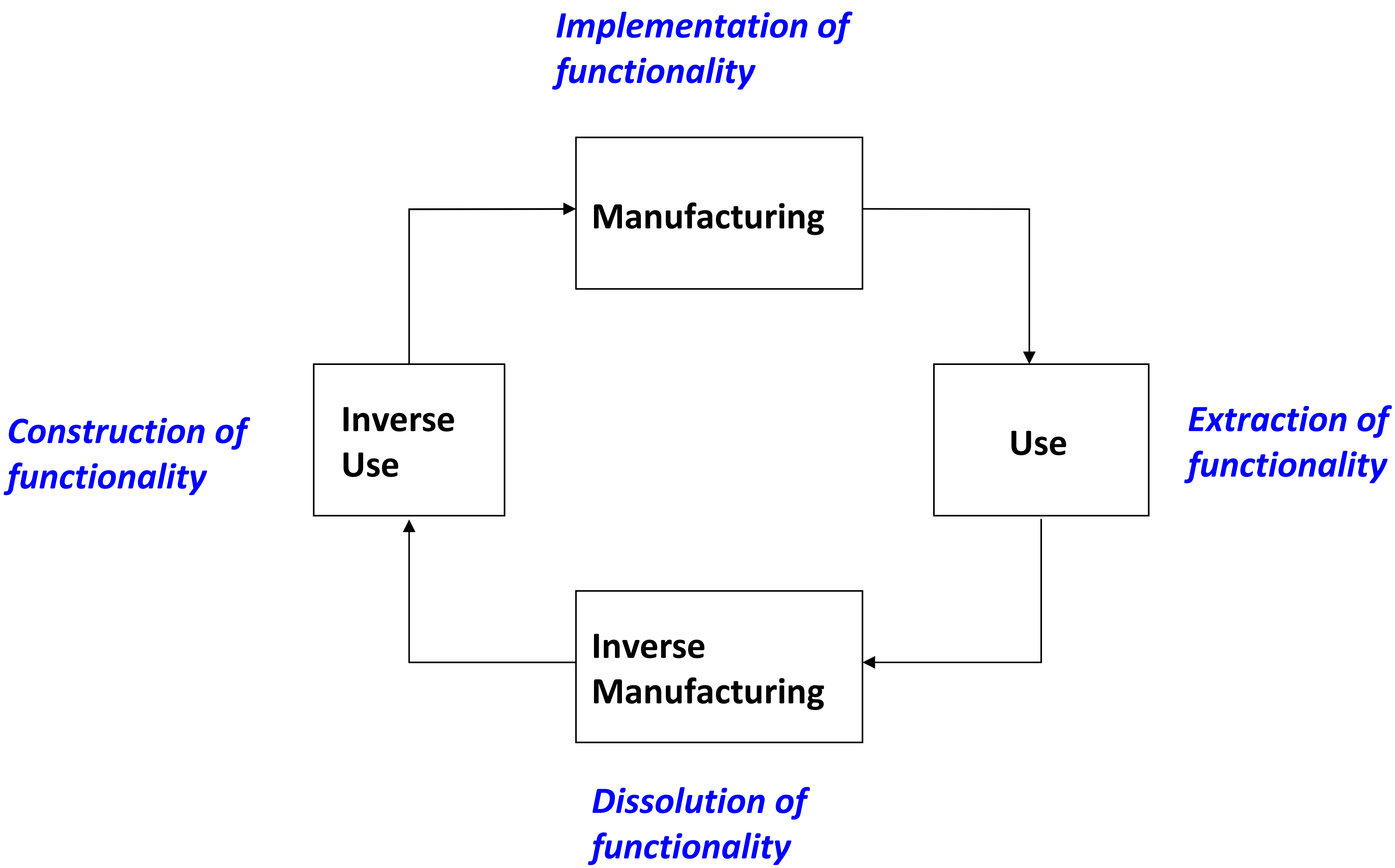
4. Functionality of a product decreases when it is used.

   $$\text{functionality} = \Sigma\ \text{service}$$

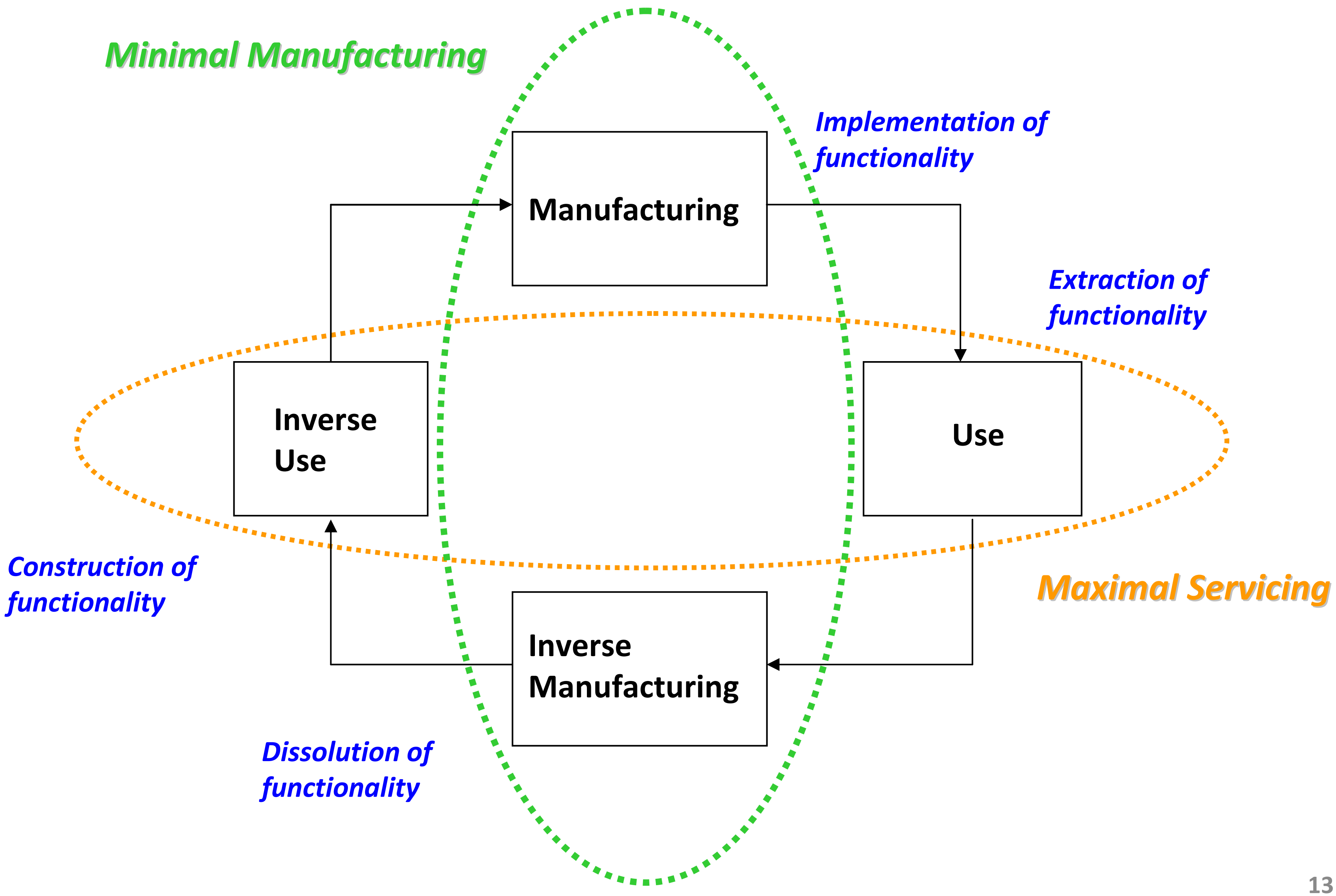
   (Life of a product terminates when services embedded are exhausted.)

5. Therefore, we can measure the potential value of a product by functionality, that is total amount of service available.

Loop in the Aspect of Functionality



Minimal Manufacturing and Maximal Servicing
for Sustainable Society



Minimal Manufacturing

***DEFINITION*:**

A manufacturing system to produce products of maximal functionality with minimal resource and energy consumption and with minimal waste

***ENABLING TECHNOLOGIES FOR MINIMAL MANUFACTURING* :**

High-density functional materials,
Nano-structures,
Nano-bio materials,
Energy efficient material processing,
Compact processes,
Self-organizing processes,
Localized clean room,
Mobile machine tools,
etc

Maximal Servicing

DEFINTION

A service system to do maximal services to people with minimal resource and energy consumption and minimal waste.

ENABLING TECHNOLOGIES FOR MAXIMAL SERVICING

Design of products with highest "density" of service contained,
Design of products that efficiently generate services when used,
Low-cost allocation of products that allow people to access easily,
Appropriate social systems to access products such as architecture,
Enough social velocity of information transmission,
Reasonable social rules to get services from products,
Sufficient longevity of products,
Automation of maintenance,
Self-repair of products,
Easy collection of wastes,
etc

Scientific Technology and Social Technology

KNOWLEDGE		TECHNOLOGY
Common knowledge	**Scientific knowledge**	
Nature	**Natural science**	**Scientific technology**
Society	**Social science**	**Social technology**
Human	**Humanities**	**Human technology**

object ≠ actor
（action:observation）

Object ≃ actor
（？）

object＝actor
（action=introspection）

object → the law → advice to action

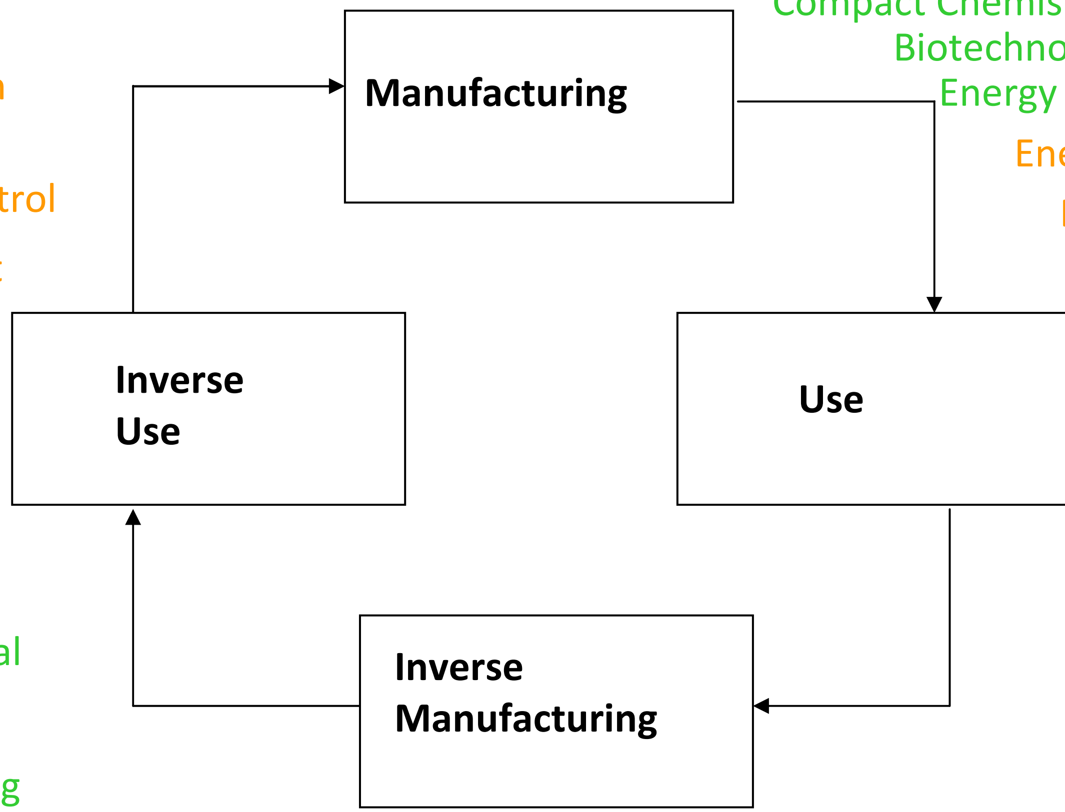
analysis *synthesis*

Related Basic Researches in AIST

for Minimal Manufacturing and Maximal servicing

Nanotechnology
Photonics
Quantum electronics
Novel processing
Green sustainability chemistry
Compact Chemistry
Biotechnology
Energy source technology

Sustainable design
Service science
Environmental control
Risk management
Computational science



Energy systems
Bio informatics
Metrology
Artificial intelligence
Brain science
Human stress
Quality of life
Digital human
Robotics
Grid technology
Security system

Sustainable material
Earth Science
Bio remedying
Biomass technology

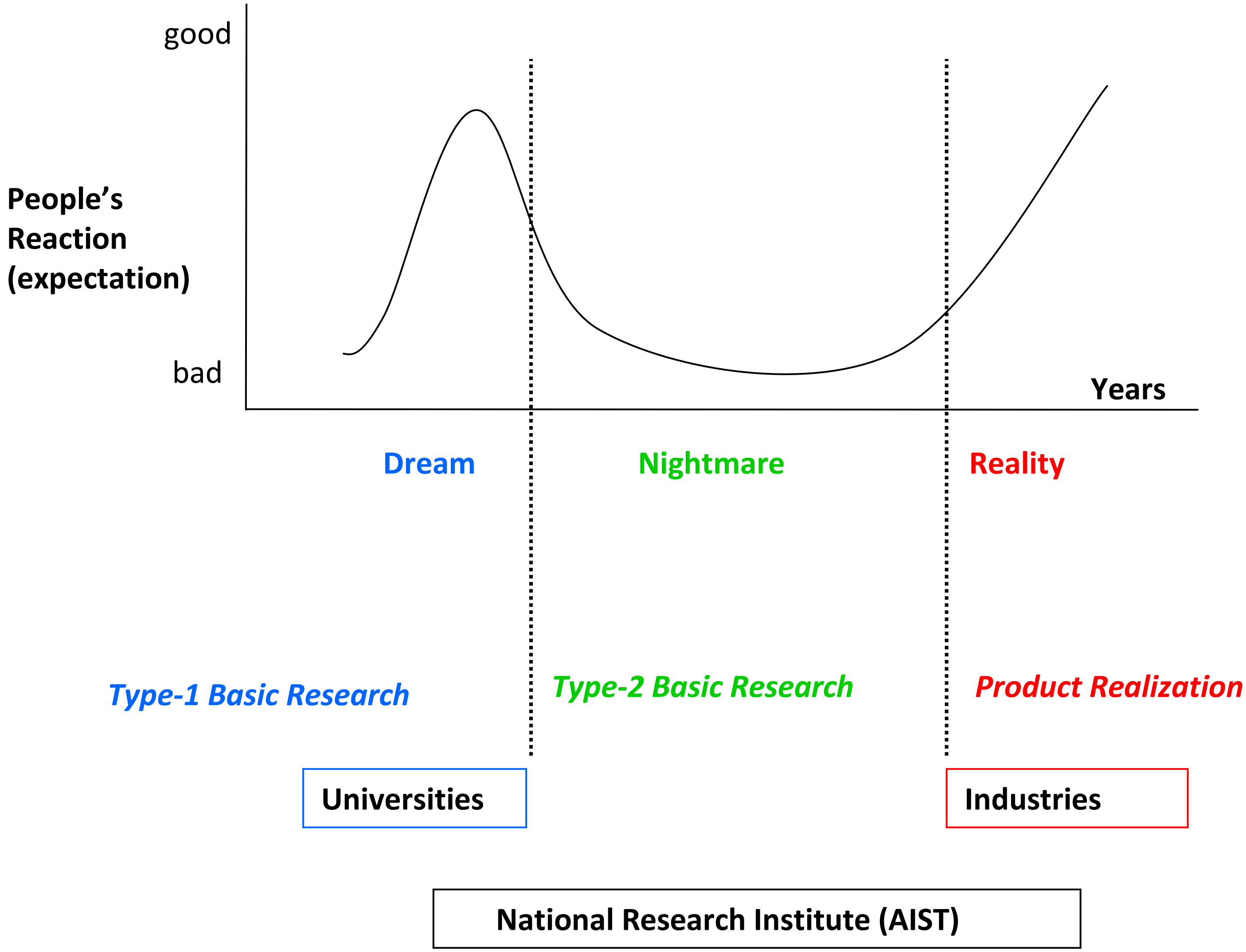
Life cycle engineering
Theory of deterioration

Ten Rules of AIST

1. Remove the lid（ふたを取る)
2. People gather, and then an organization (人がいて組織が)
3. Autonomy of research unit（研究ユニットのオートノミー)
4. Full research（本格研究)
5. Research strategy written in scientific words（科学の言葉で書かれた戦略)
6. Division of the three powers（三権分立)
7. Fractal of organizations（組織のフラクタル)
8. Time constants of people and organization（人と組織の時定数)
9. Network of excellence（卓越した機関のネットワーク)
10. Common target（共通の目標)
    "Research to move the centre of gravity of industries toward sustainability"
    （"産業の全体がサステナビリティに向けて重心移動するために必要な研究"）

HY

“Full Research”



Full Research

Type-2 Basic Research

(1) Type-1 basic research aims at creating new knowledge about facts, but type-2 basic research aims at creating new values* for society.

(2) Type-1 basic research is conducted by an authorized method: "scientific method", but type-2 basic research has not yet an authorized method.

(3) Type-2 basic research has two missions: creating values for society and establishing a general method of value-creation.

(4) Type-2 basic research is "basic" because of the latter mission of (3) that would contribute to accumulate systematic knowledge for value-creation.

(5) Results of type-2 basic research can not be verified systematically due to lack of general method of research, hence social acceptance is the criterion.

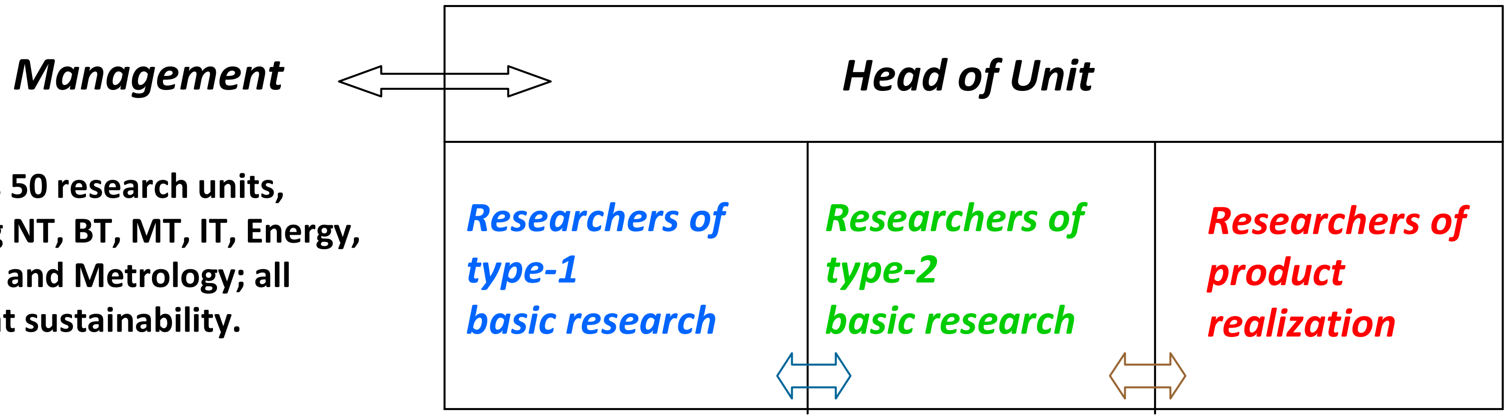
(6) Type-1 basic research is analytical but type-2 basic research is synthetic.

(7) Type-1 basic research is normally conducted within a single scientific discipline but type-2 basic research is basically discipline-free.

**** The word "value" is used here in a broad sense: some knowledge effective to society***

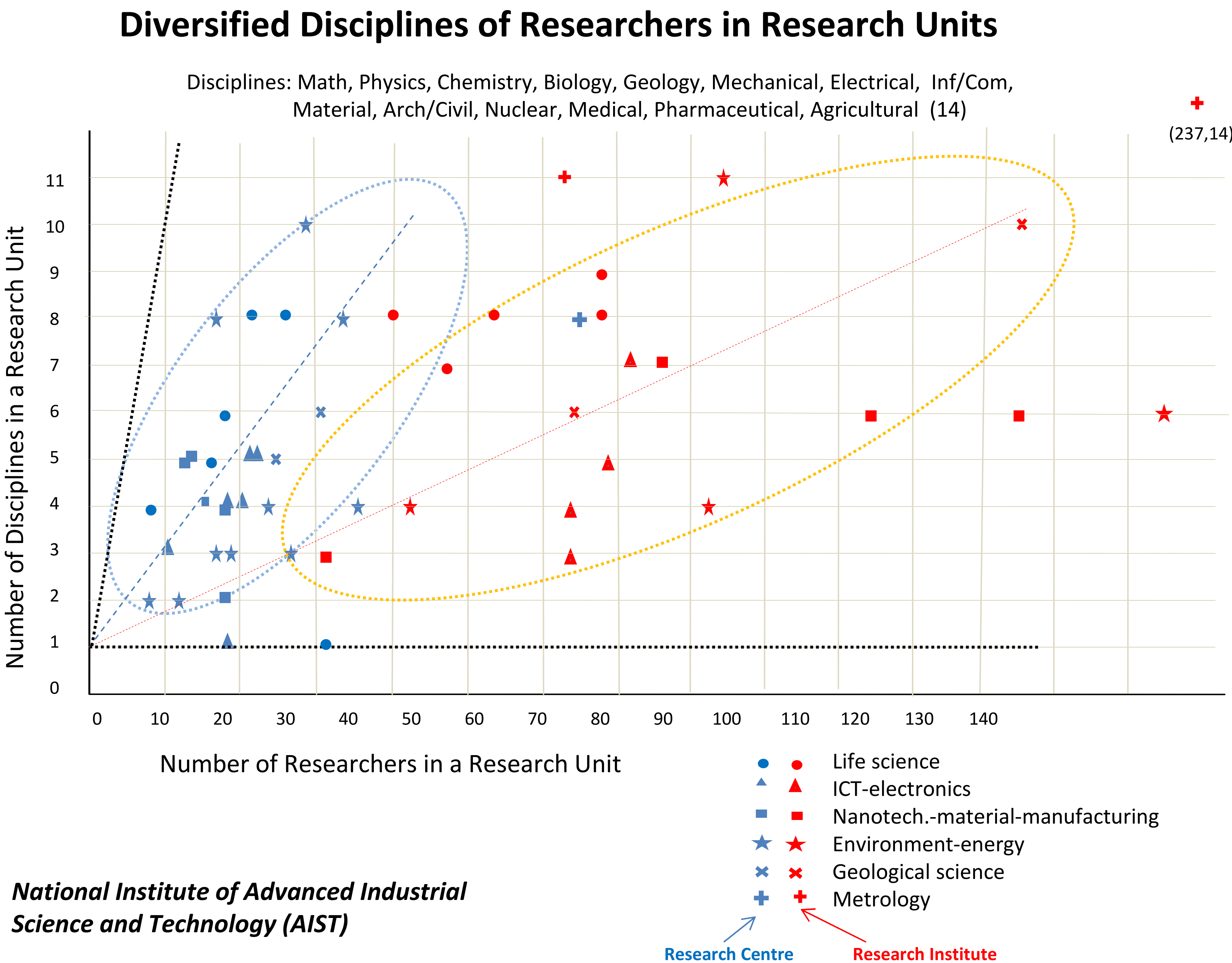
Research Unit in AIST for Full Research

Aim of AIST : Create technologies necessary to realize sustainable industry



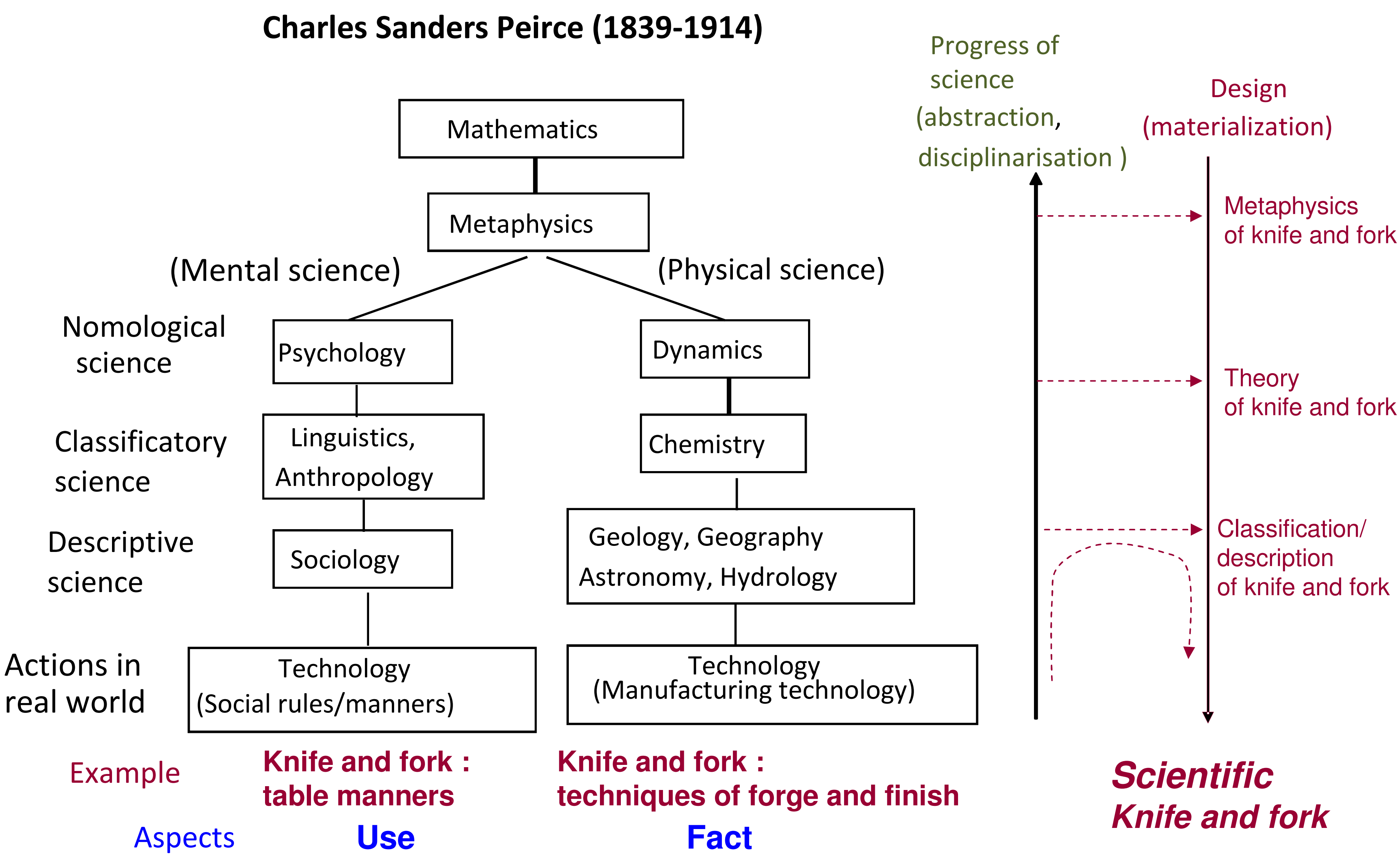
AIST has 50 research units, covering NT, BT, MT, IT, Energy, Geology and Metrology; all aiming at sustainability.

(1) Unit has a mission to innovate particular knowledge/technology for society/industry.
(2) Head of unit directly communicates the management of AIST.
(3) Head of unit is given full autonomy for conducting the research.
(4) Management keeps the authority of start/reform/abolition of unit.
(5) All researchers in the unit always bear its mission in mind.
(6) Type-1 basic researchers aim at generating new scientific knowledge.
(7) Type-2 basic researchers aim at creating new values for society.
(8) Product-realizing researchers aim at creating products/knowledge for society.
(9) Three groups are integrated by the head to conduct research coherently and concurrently.
(10) Researchers are free to move among three categories.
(11) In order to realize such research unit, head of unit must be an "autonomous thinker", who is ethical and philosophical.

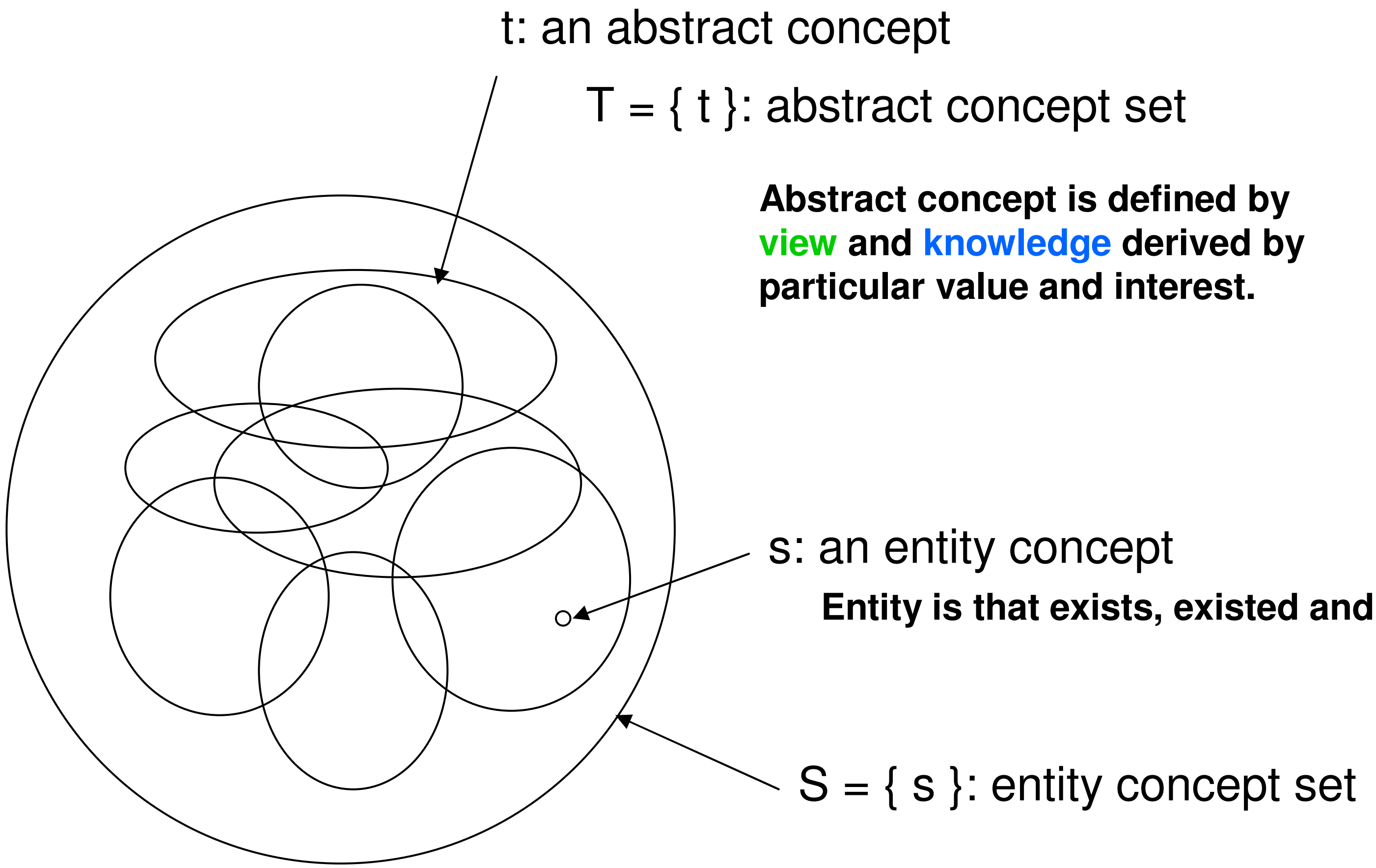


Diversified Disciplines of Researchers in Research Units
Disciplines: Math, Physics, Chemistry, Biology, Geology, Mechanical, Electrical, Inf/Com, Material, Arch/Civil, Nuclear, Medical, Pharmaceutical, Agricultural (14)
(237,14)
Number of Disciplines in a Research Unit
Number of Researchers in a Research Unit
0 1 2 3 4 5 6 7 8 9 10 11
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
Life science
ICT-electronics
Nanotech.-material-manufacturing
Environment-energy
Geological science
Metrology
Research Centre
Research Institute
National Institute of Advanced Industrial Science and Technology (AIST)

Peirce's Classes of Science (separation of knowledge)



Topological Structure of Human Knowledge

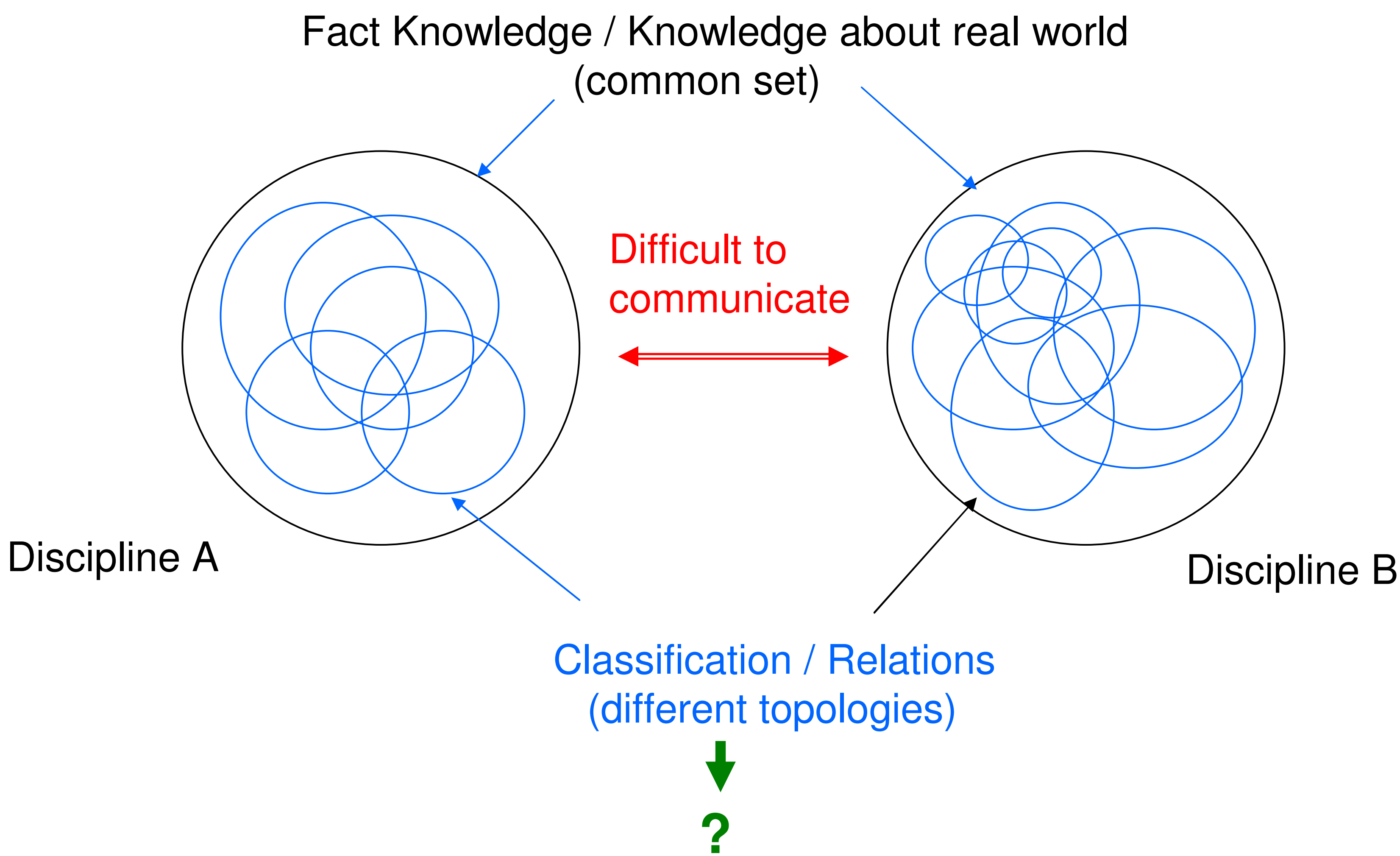


Abstract concept is defined by view and knowledge derived by particular value and interest.

Entity is that exists, existed and will exist .

Human knowledge, (S,T), is a topology. A discipline has an intrinsic topology.

Integration of Different Topologies

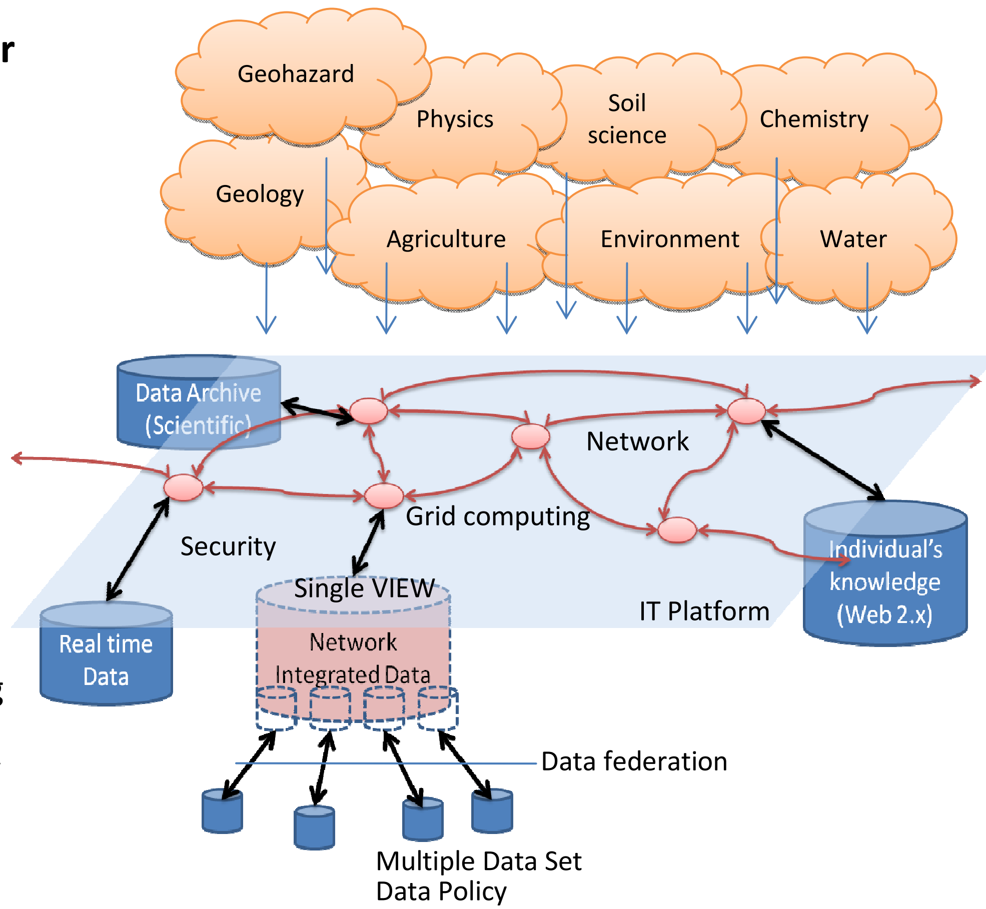


Collective Intellect in Science

- **Collective knowledge /data is the key for multi disciplinary science, and**
- **Diversity is nature of scientific data**
  - **Geographical distance,**
  - **Multiple ownership (individual/organization)**
  - **Variety of data access protocols**
- **Design and Solution**
  - **Keep the data AS IS, and provide users with SIMPLE VIEW.**

    Data sets are so huge, single archive impossible

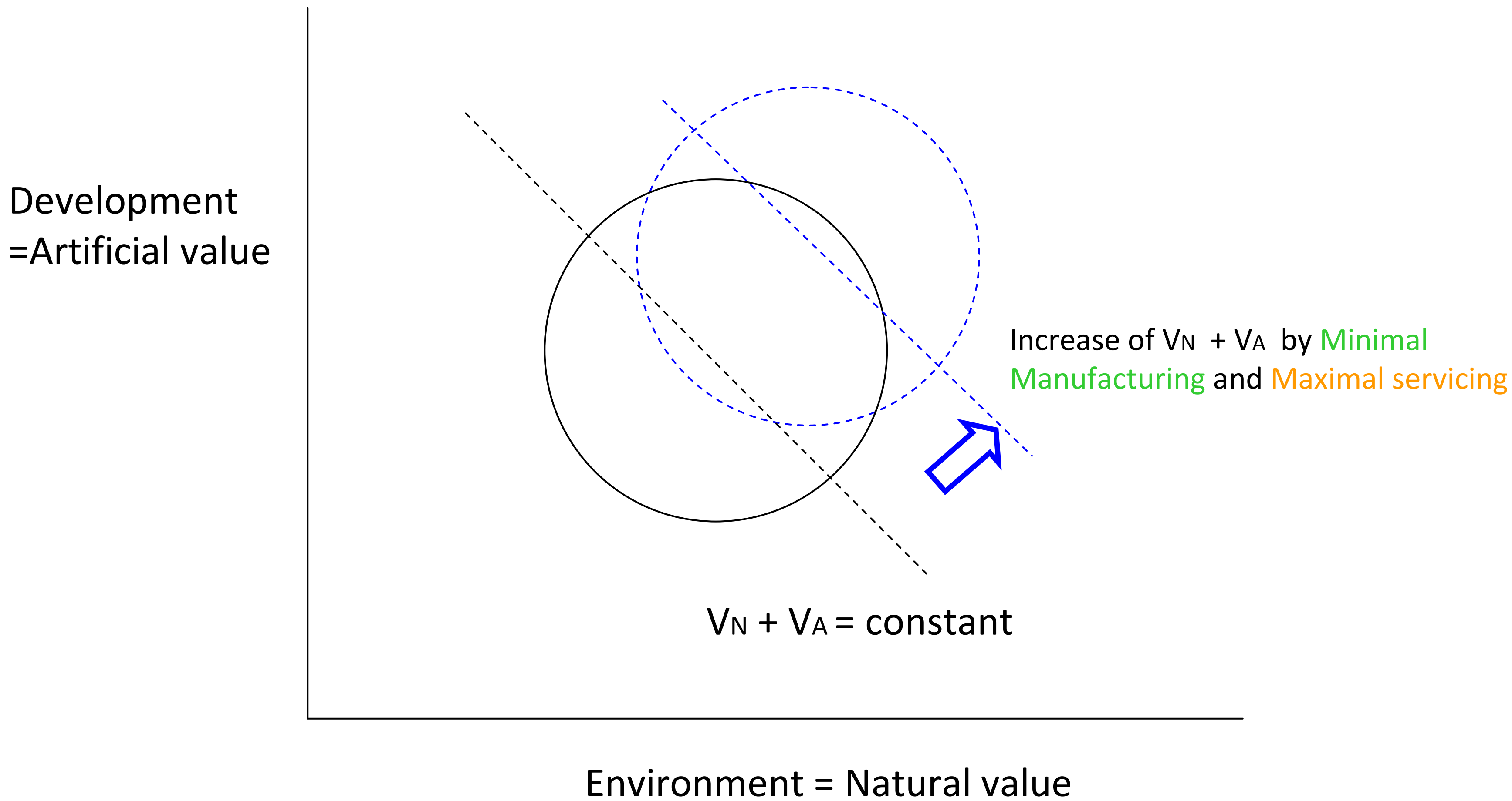
    - Maintain Multiple (distributed) archive sites corresponding to geographical diversity and retaining the data policy
    - Provide Single VIEW for users easily to access the data
    - Diminish geographical distance by high speed network



GEO Grid - a good example to implement this concept, is AIST's initiative intends to integrate earth observing data over network including multiple Satellite imageries, geology data, CO2 monitoring etc. by using advanced information technology such as Grid.

Making a Shift toward Sustainability

“Industrial transformation”



HY

We should develop many other evolutionary loops that include society and science community.

Followings are important actions already started, that will be discussed elsewhere, from the view point of loop.

International Conferences: World Economic Forum (Davos)
World Science Forum (Budapest)
STS(Science and Technology in Society) Forum (Kyoto)
BioVision (Lyon, Alexandria)
World Knowledge Dialogue (Crans-Montana)

United Nations: Framework Convention for Climate Change (FCCC~IPCC)
Commission of Sustainable Development (Major Groups ~ Governments)
Global Compact (UN ~ Business)

UNESCO: Decade of Education for Sustainable Development (UNESCO ~ Nation educators)

etc.

【End of Presentation】

HY