Symbiotic system

as a new social infrastructure based on intelligent interaction among the society, human beings, and information systems

Sep.12th, 2011

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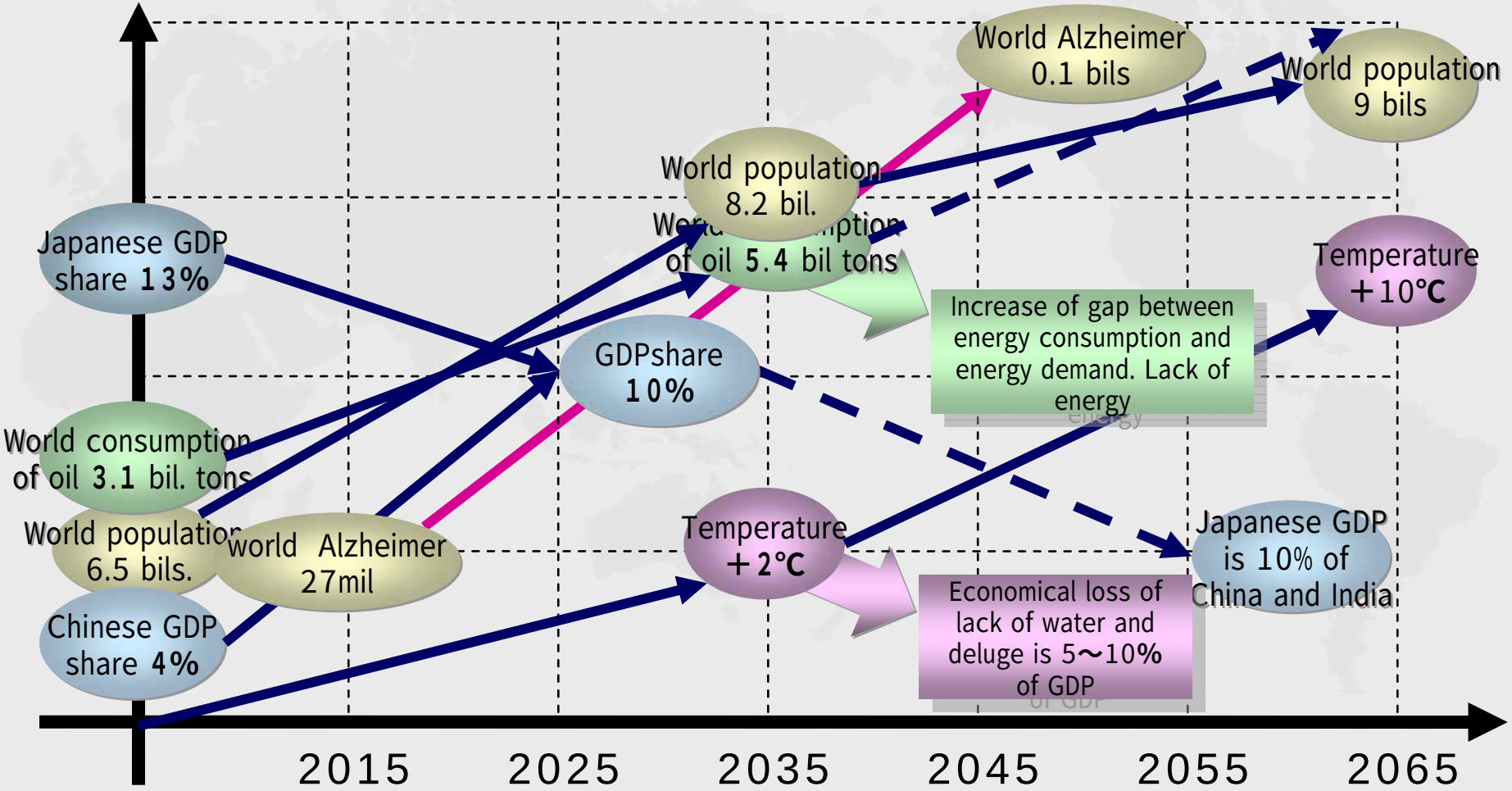
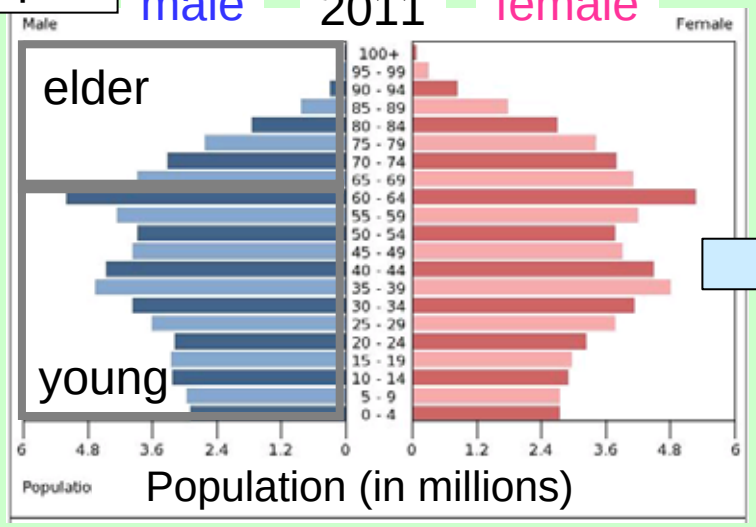
World trend of the 60 years in the future



Increasing population of elderly people

Japan

male 2011 female



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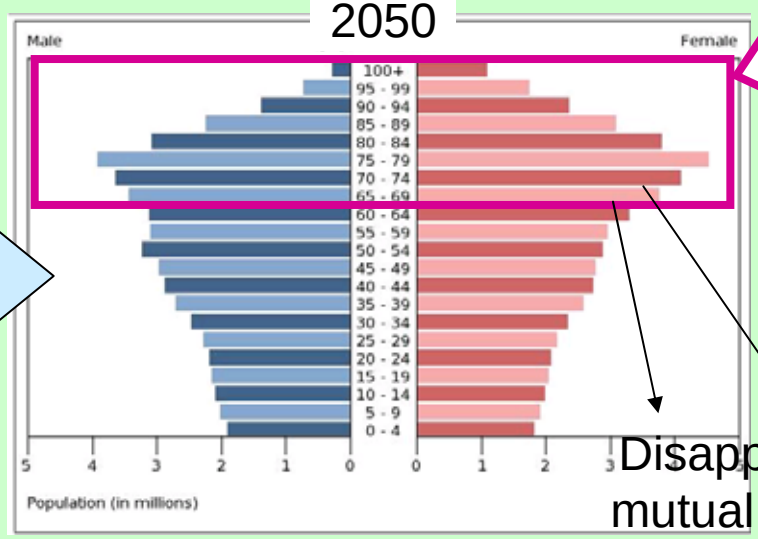


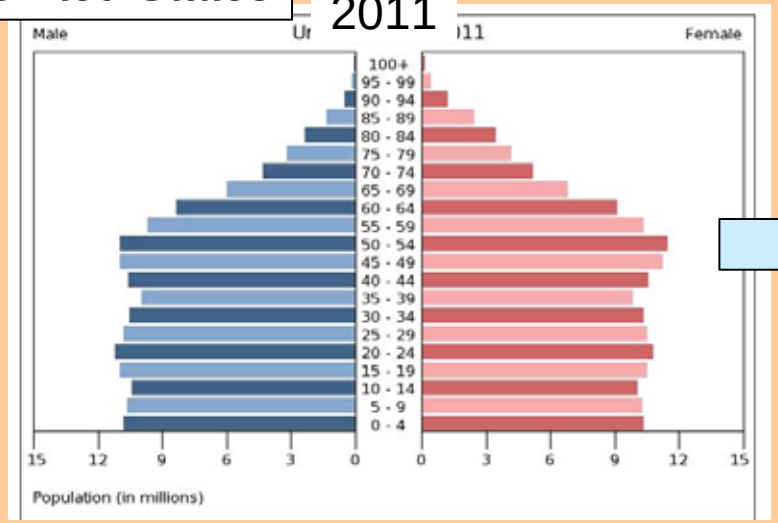
40% of Population Become elderly

Isolation

Disappearance of mutual assistance

United States

2011



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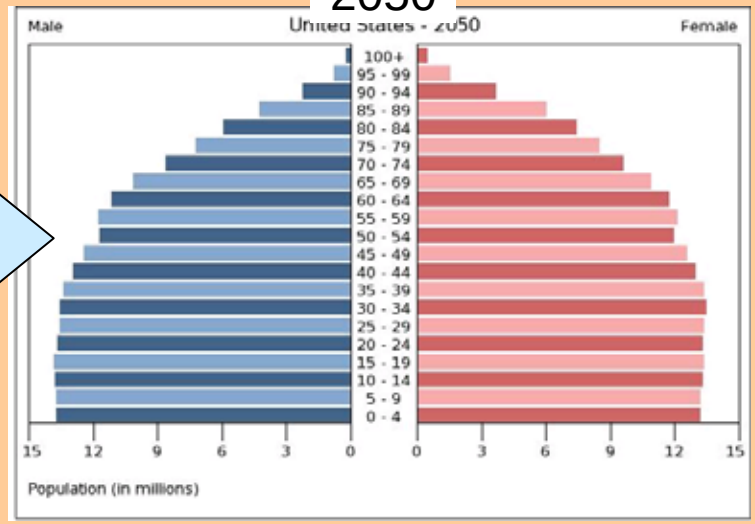


U. S. Census Bureau International Data Base (2011)

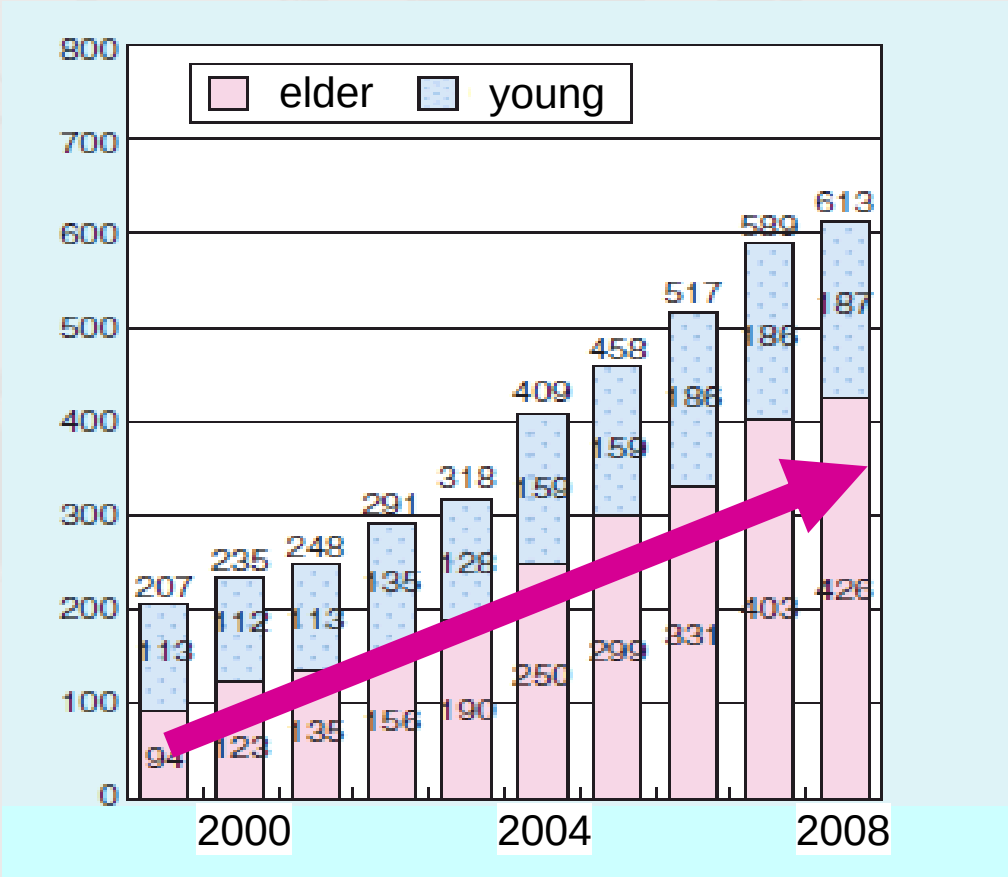
Increasing isolation of elderly people in Japan

- **40% of elderly people don't join group activity in local community (The Cabinet Office, Government of Japan, 2010)**
- **16% of elderly people lives alone**

(Ministry of Internal Affairs and Communications, Statics Bureau, 2011)

- **Increasing solitary death of elderly people**

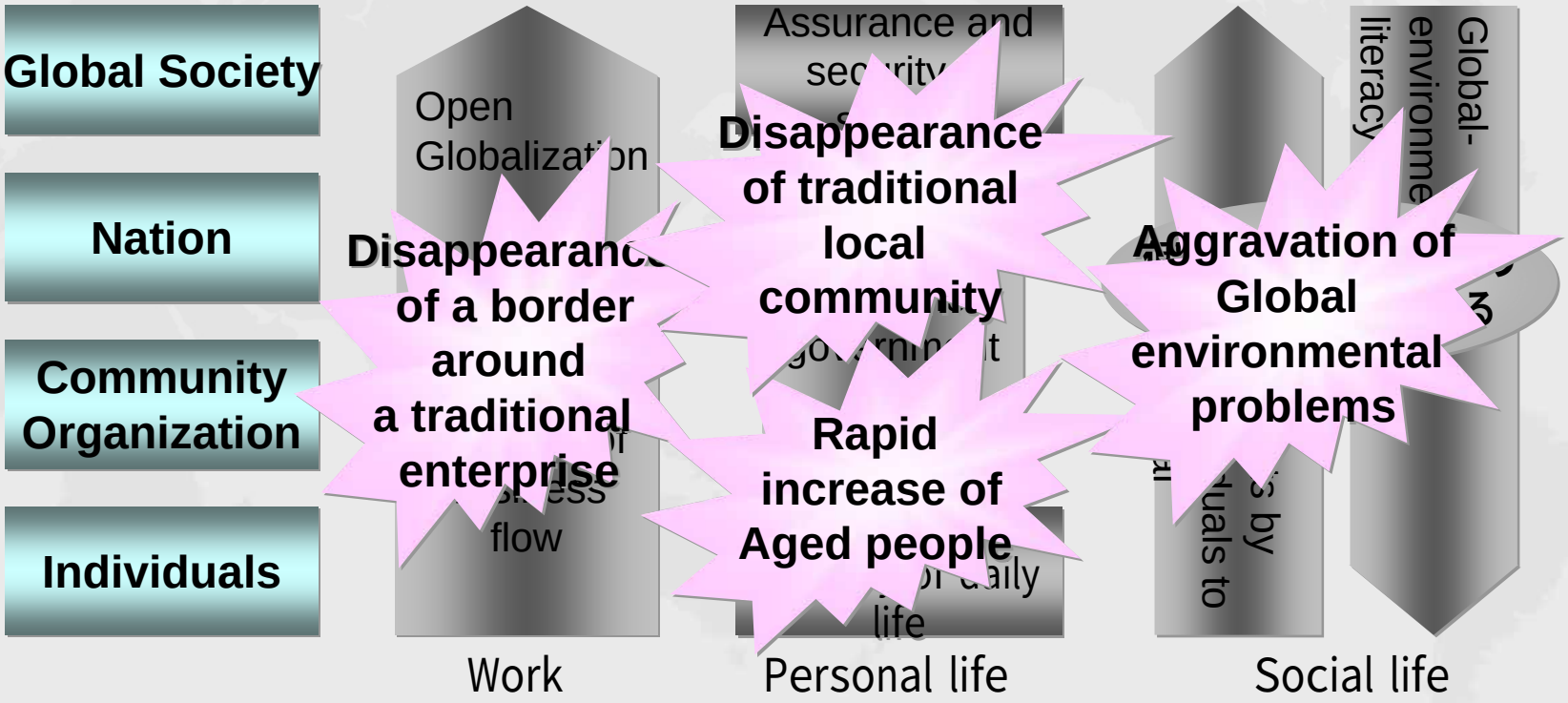
(Urban Renaissance Agency, 2008)



Counting by a housing management organization

Elderly people: more than 65 years old

Three important issues in the next 30 years



Big companies will vanish
Many independent workers will remain

Traditional national governments can't stop the aggravation.

How to solve global problems

- **Limitations or misunderstanding on our current society keep it with unsolved problems.**
- **Removing such limitations on the society will smoothly change to be free from the suppression by the problems.**

	Problems predicted	Limitations to be removed
Daily life	-Increase in number of old people living alone -Increase in social welfare costs	-Daily life is restricted to limited places Family members -Older people are less active
Work	-Fluidization of human resources weakens competence of company	- Much tacit knowledge in an organization - Know-how collects in workers' brains
Society and community	-Indifference to social affairs -Aggravation of global environment	-Individual behavior does not influence society -People can't sense gradual change

Personal Life of 30 years in the future

- **People of 80 years old will actively contribute to the society.**
- **This system enables family members to communicate peacefully with one another than that they live together.**

Trainer for increasing health

Prosthesis of activity

Life assistance

Remotely living together

Tele-education

Technology issues

Mind communication

Robot assisting daily life

Nonverbal communication

Smart town

Remotely living together

Prosthesis of perception

Analysis of health condition

Understanding intention

assisting education in life time

Open co-creation system

- **Every person will be able to play an active roll by his own specialty.**
- **The system will assist people in collaborating with others to accomplish big business though they seem to be working randomly at a glance.**

Maximization of intellectual productivity of open community

Harmonization of individual activities and Feedback them to global society

Global tele-collaboration

Maximization of individual creativity

Technology issues

Mechanism of inspiration

Intellectual productivity

Community management

Global tele-work

Open work-flow

Global human resource management

Coaching

Protection of originality

Assisting life-time education

Global collaboration system

promotes all of the people to collaborate for solving the global problems coming in the future.

- **The system removes many barriers such as ones in inter-cultures, ones in inter-generations, ones between individuals and the society.**

Giving suitable information to individuals

Assisting comprehension of global problems

Overcoming barriers of mutual understanding

Assisting spontaneous behavior.

Spreading individual activities

Reporting contributions to individuals

Tech issues

Dynamics of information explosion

Comprehension of global problems

Analysis of complex mutual dependency

Personal adaptation improves information literacy

New generation of mass media

Cross-cultural collaboration

Activity monitoring

Coordination of opinions

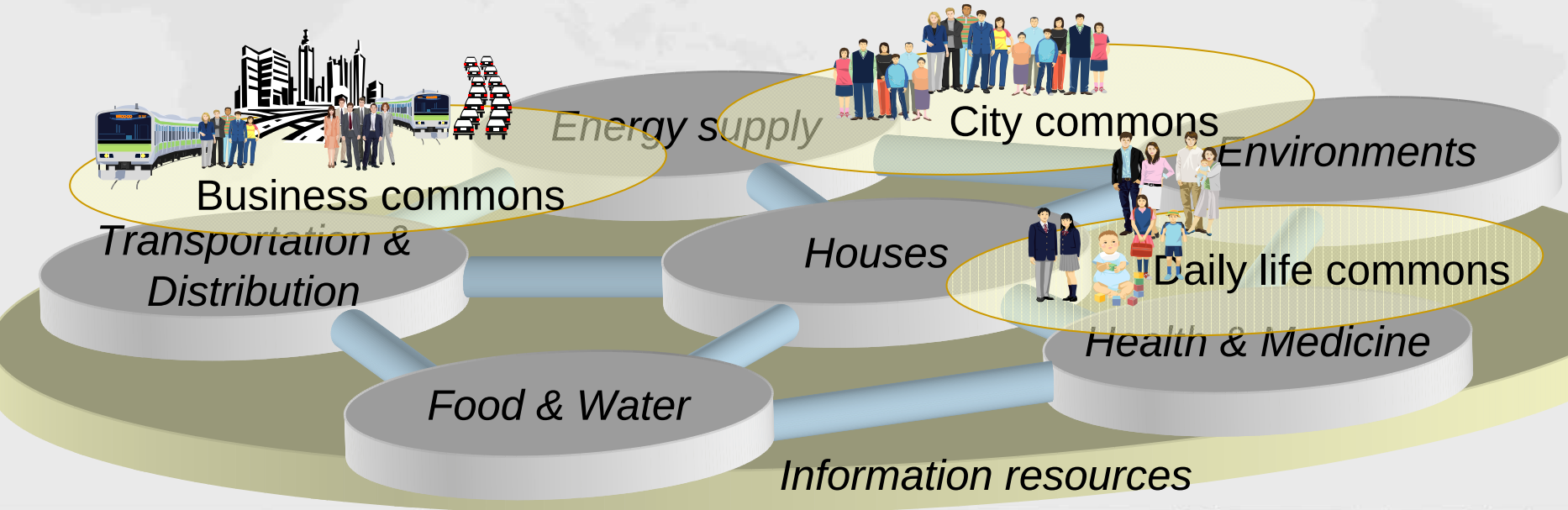
Evaluation of information reliability

Symbiotic technology

fusion of socio-technology and scientific technology
realizes symbiosis
between people and society,
between people and natural environment,
among people
between people and information systems

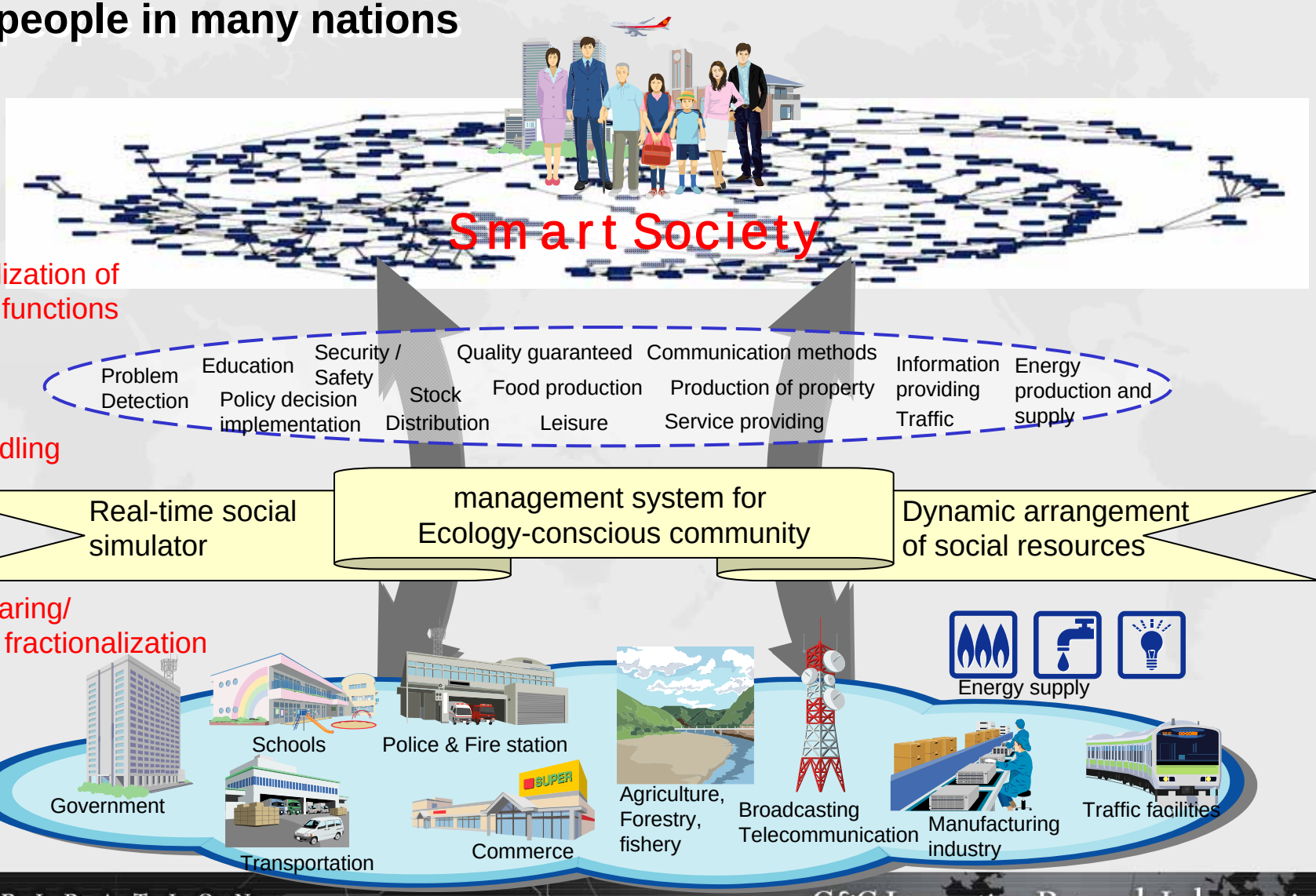
Social infrastructure by Symbiotic tech.

- **Key idea is based on “Shift from Ownership to sharing”**
  - **Sharing and utilizing social resources：(like virtualization of computers)**
    - **Human resources (connection of people)**
    - **Town resources(Transportation, Distribution, Energy supply, Food & water supply, Environment, Health, Houses)**
    - **Information resources (data, IDs, knowledge sharing)**



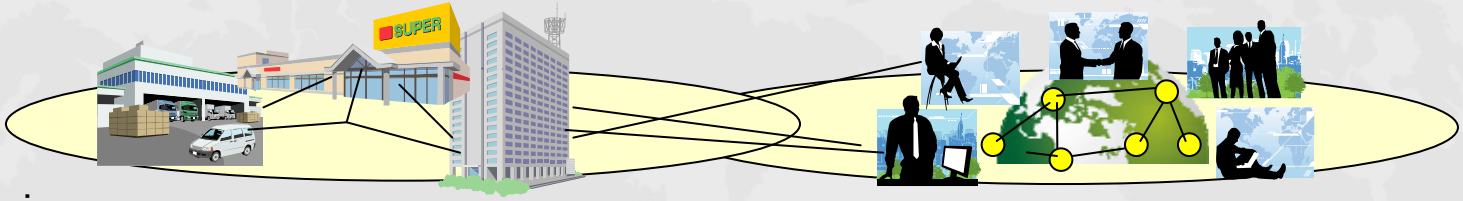
Integrated city infrastructure

Social functions will be virtualized and shared by people in a city or people in many nations



Open Co-creation platform

Virtualization of business process will realize business activities by floating organizations.



Business
by compound companies

Solution of global problems by
human networks

Rebundling

Global restructuring of
business process

Global transactions and distribution
of intellectual properties

Time sharing/
function
fractionalization

Fractionalization of
transactions

Measurement and
evaluation of
Intellectual productivity

Segmentation, record,
communication of
Workflow

Platform for open business process

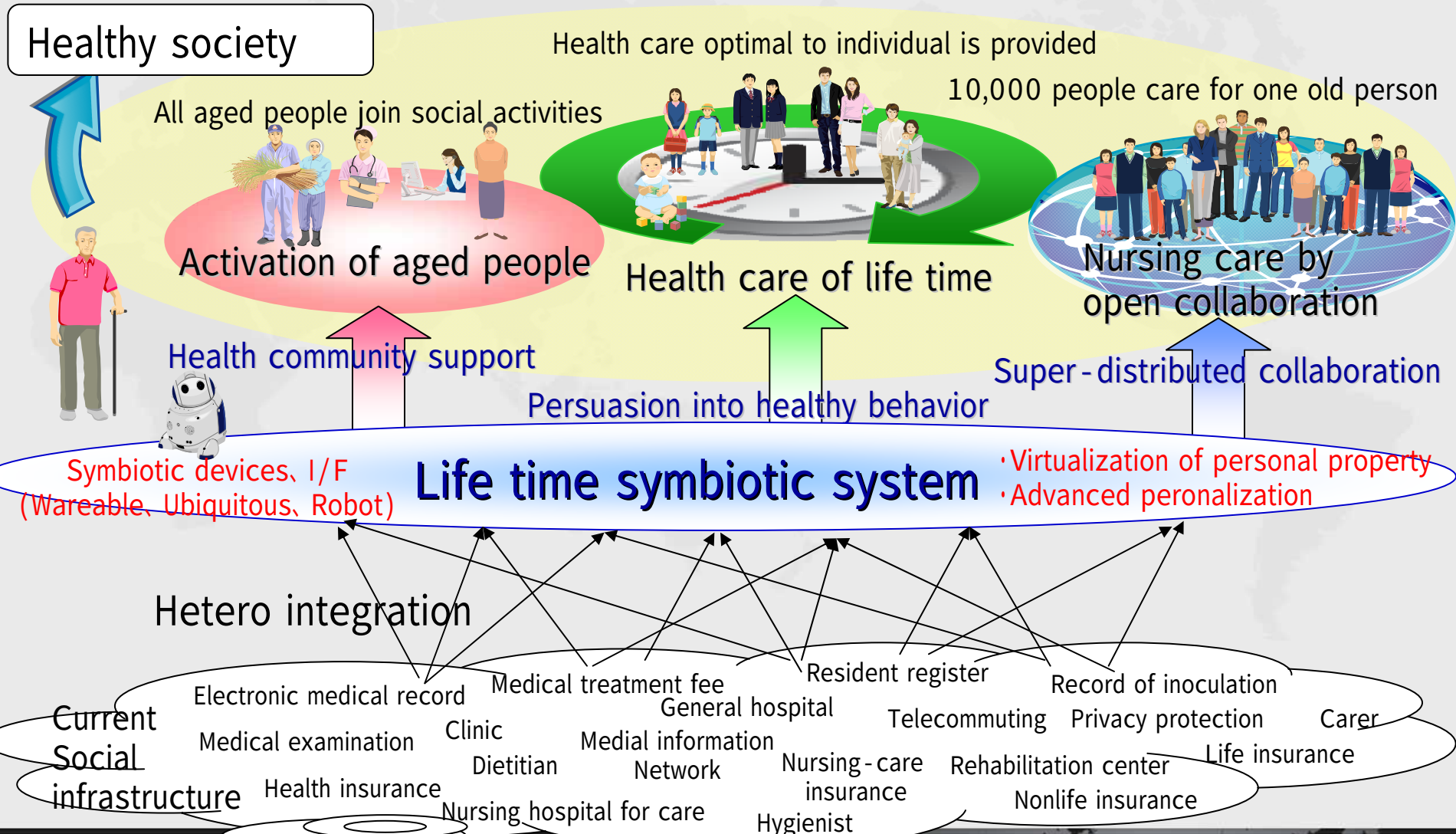
Current
business
process

Distribution
Planning
Production
Design
Development
Project management
Quality management
Arrangement
CRM
Transaction of Trust
Human resource
management
Work share
Skill training
Education
Work life balance

Personal
Small /
Medium enterprise
Large enterprise
Local government
Educational system

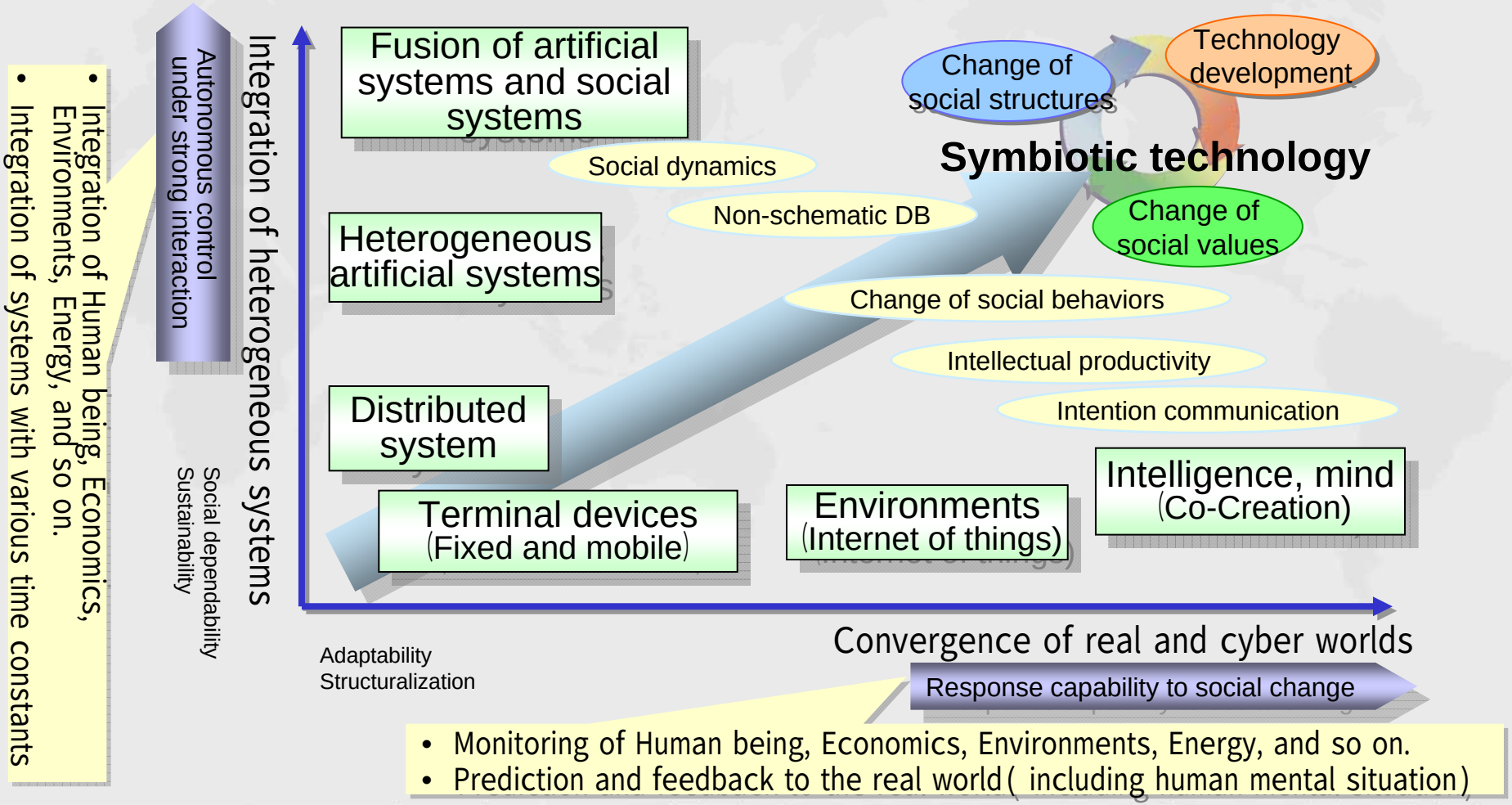
Total Guard system

Promotes everybody to participate social activities, improves everyone's health condition, and decreases social welfare costs



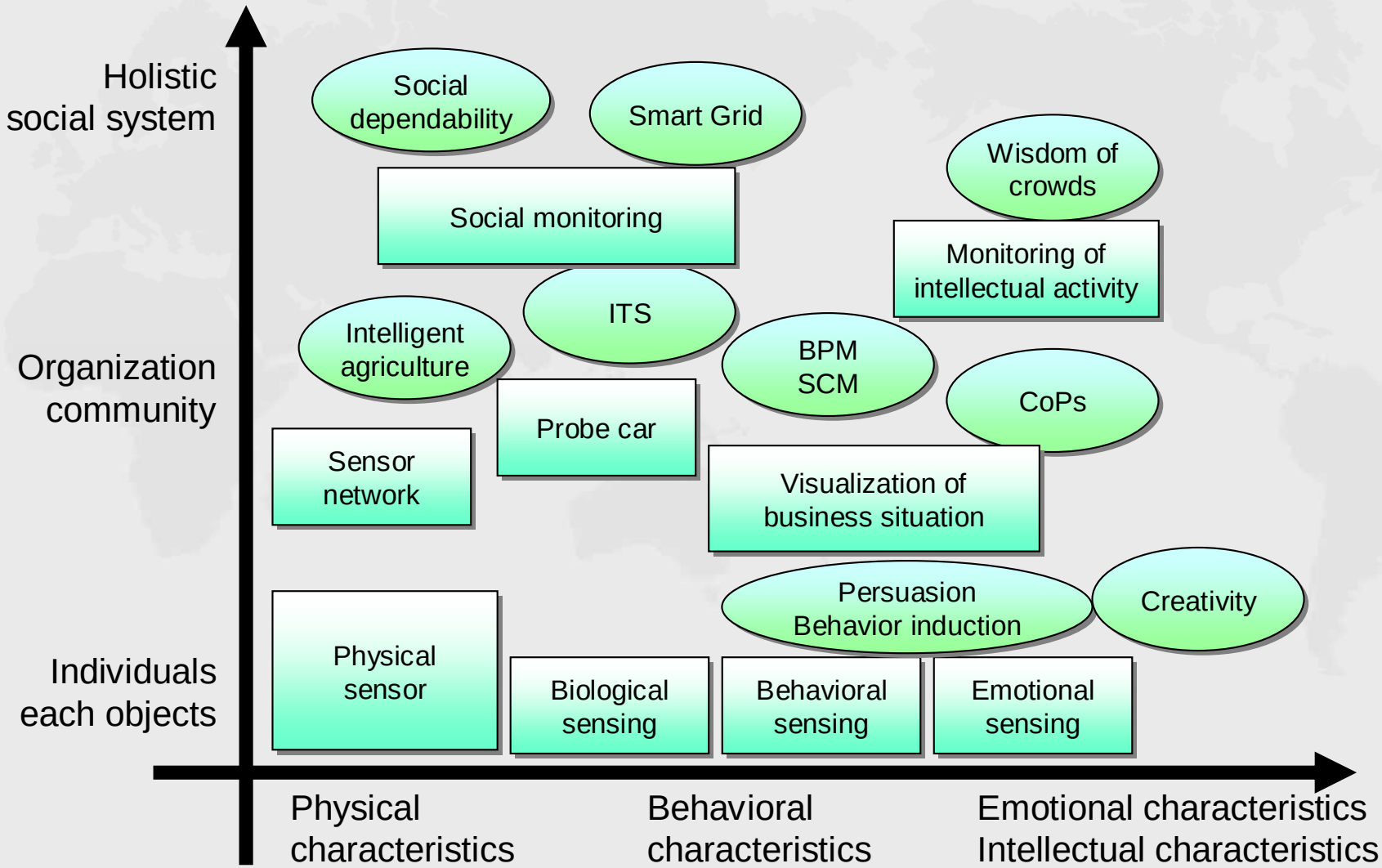
Two dims. of symbiotic technology

- **The next stage is to combine socio-technology and scientific technology.**



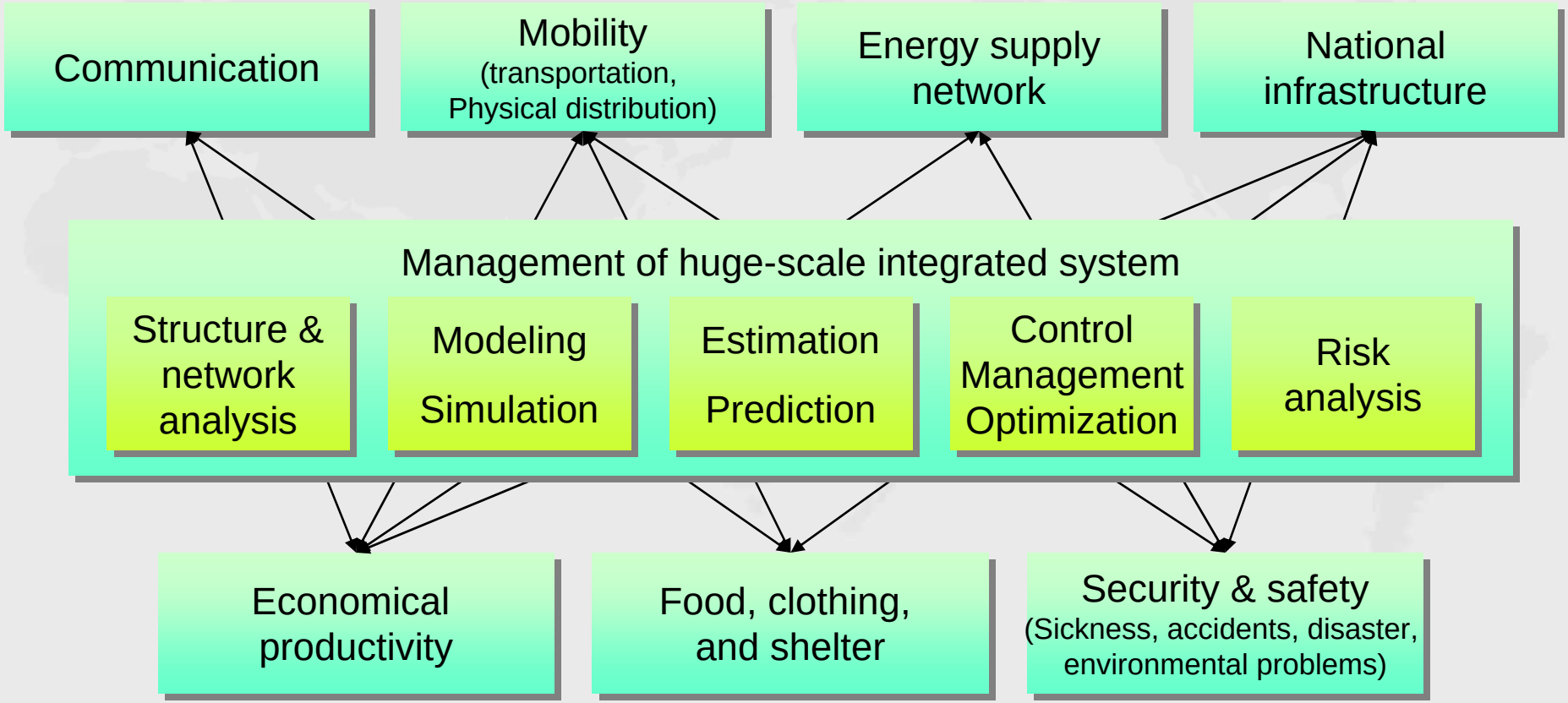
Convergence of the real and cyber worlds

- **Two dimensions: characteristics and size of party**



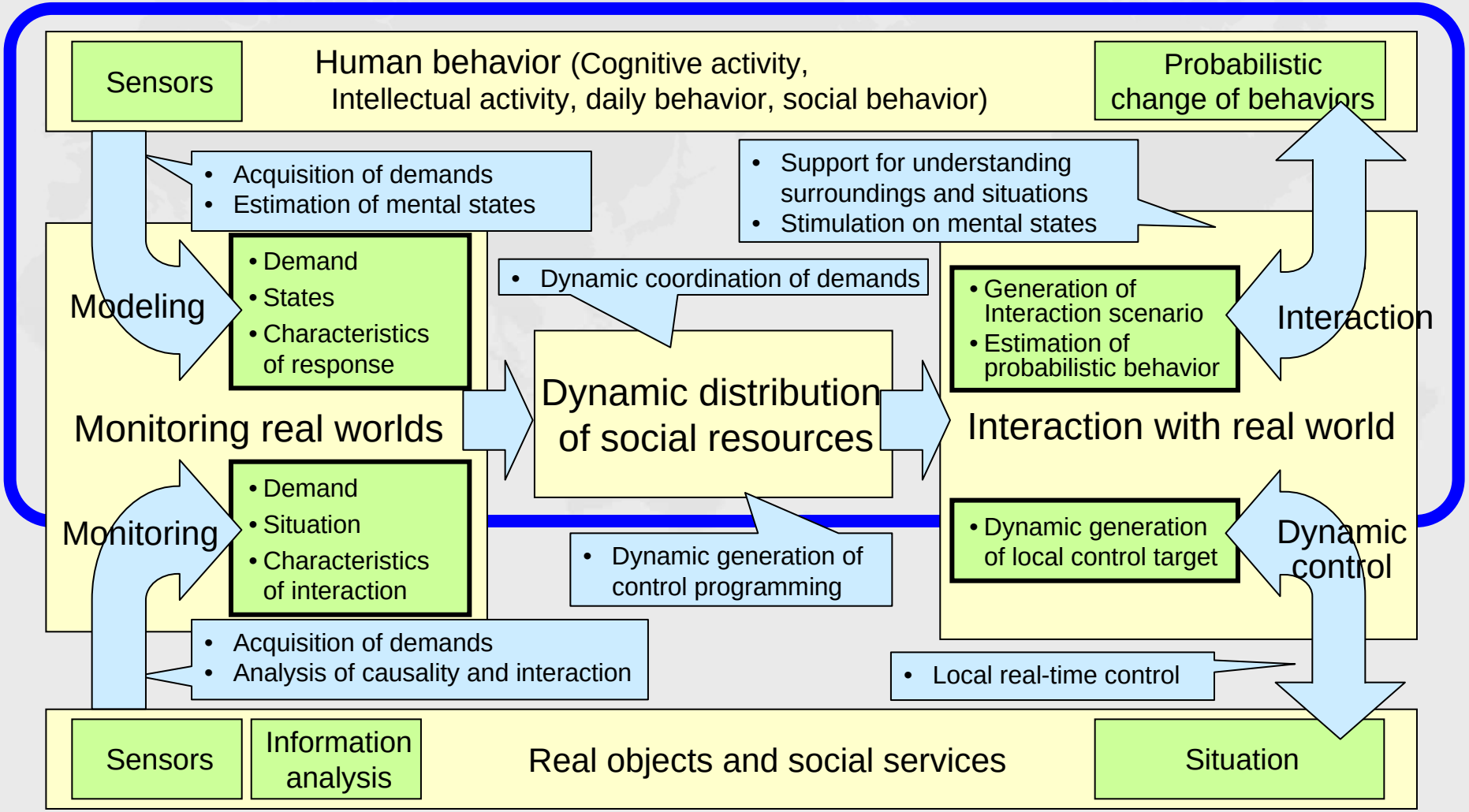
Hetero-systematization

- **Individual systems grow and are entangled.**
- **Design method of huge-scale integrated system is necessary.**



Architecture of symbiotic system

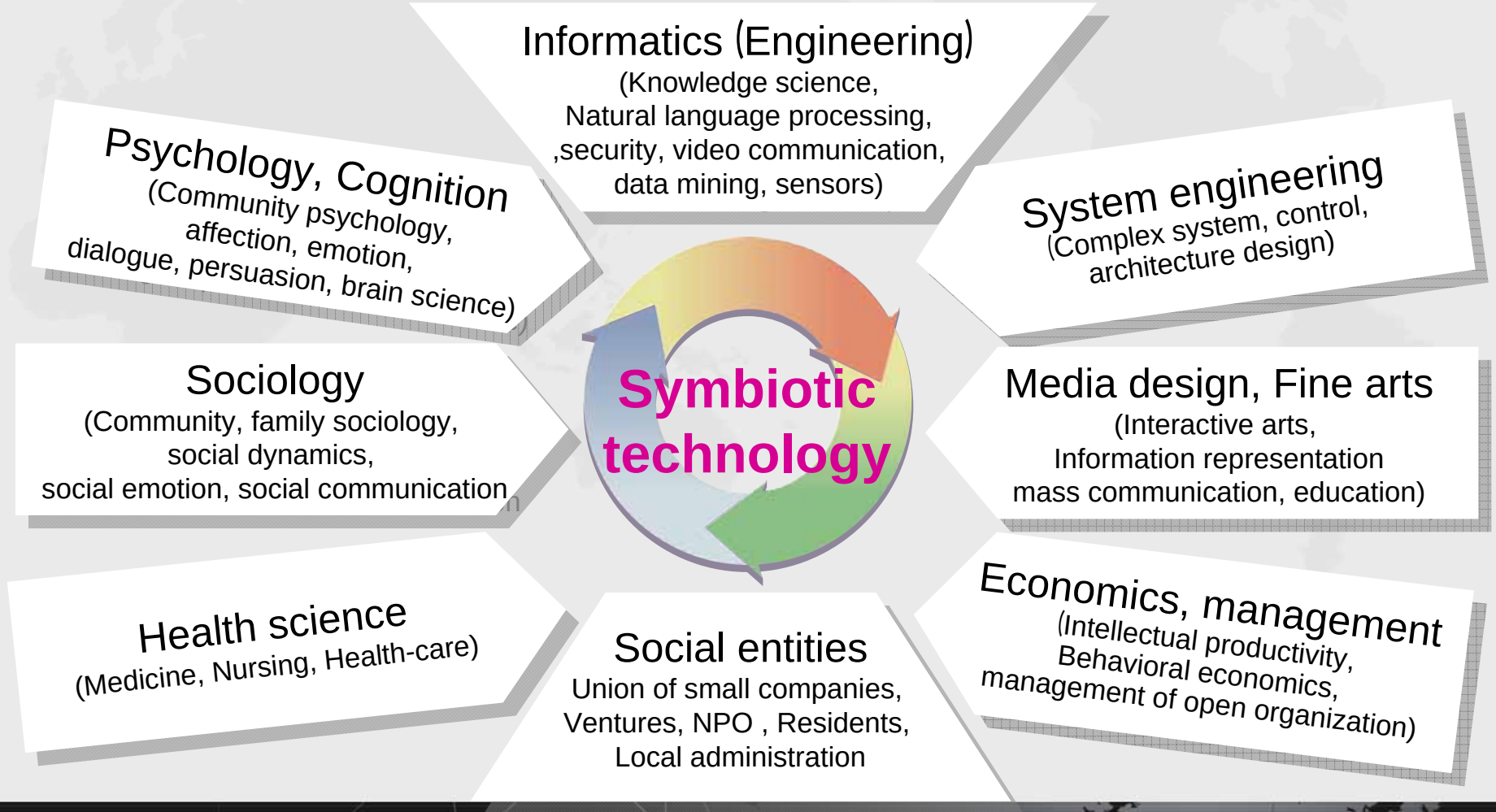
- Combines dynamic control of social hard-ware and promotion of spontaneous human activity



Technology development and Field evaluation

Inter-disciplinary collaboration

- **For developing symbiotic technology (fusion of socio-technology and scientific technology), interdisciplinary collaboration is essential.**

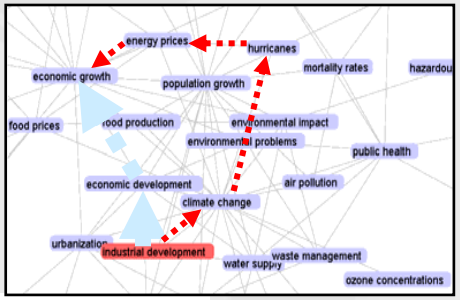


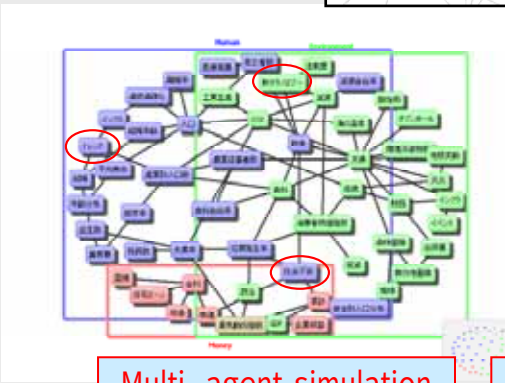
Future exploration

- **We extract structure of dynamics in the real world by using natural language processing and multi-dimensional pattern processing.**
- **Understanding of reciprocal influences in the real world helps us to predict issues which will occur in the future.**

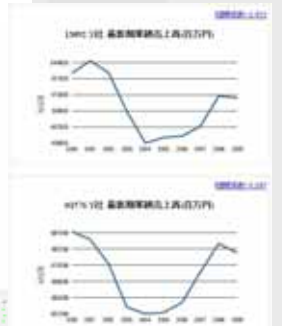
  - **Chronological event (CE) retrieval**
  - **Causal network analysis**
  - **System dynamics**
  - **Multi-agent simulation**

  - **Workshops in our future center**





Multi-agent simulation using causal network



Extraction of correlated changes

Chronological event (CE) retrieval

: Extracts future or past events from a huge amount of documents.

Future of "Photovoltaic cell (PV)"

PV ∧ (2011 ∨ 2012 …)

Search

Search API

Presenting events as a list

query and time expression

Extraction

Denoising (SVM)

Selection

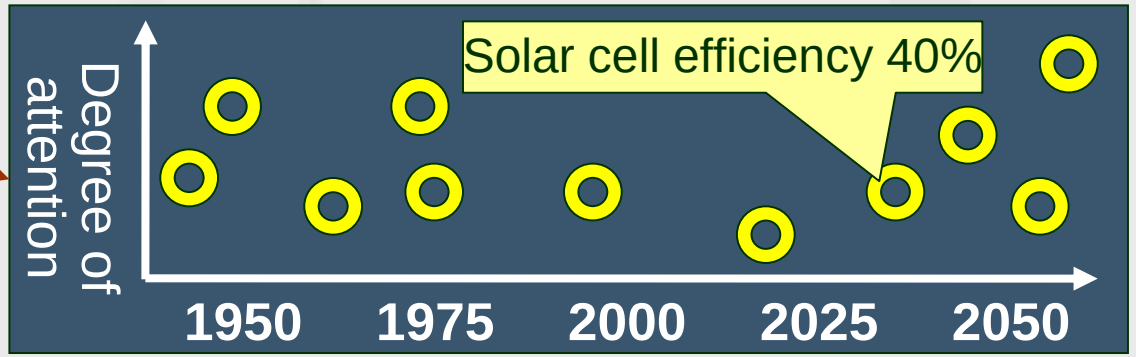
Clustering (sets of similar events

Structuring

Visualization

Presenting events as year expression

2015	**Organic thin film PV accounts for 30% of solar cell**
2020	**Market size of solar cell will be $100 bil.**
2030	**Solar cell efficiency 40%, ¥7/kWh**



A method for CE extraction

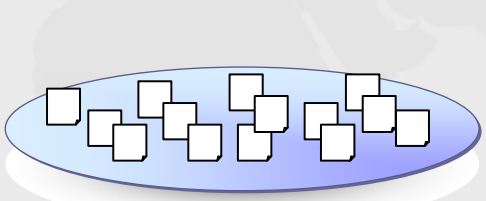
- **We introduced expansion of query terms for improving recall rate.**

expansion	Future	Past
Time determiner TD	till, until, by, in , before, etc.	In, of , till, from, since, etc.
Time expression TE	From ** to **	—
Context term CT (frequently added words)	prediction, target, estimate, increase, decrease, future, down, up, peak, etc.	origin, source, first, start, discover, establish, foundation, completion, etc.

	Precision	Recall	F-value
Baseline	**0.648**	1.000	**0.786**
UG (Unigram)	**0.798**	**0.851**	**0.824**
UG+LM+CT	**0.807**	**0.861**	**0.833**
UG+LM+CT+SS+IY	**0.825**	**0.873**	**0.848**

Causal network analysis

- Causality analysis can be applied to extract dynamic relationship in the real world.
  - It can extract structures of knowledge by integrating a lot of partial information in WWW, documents, and the real-world.
  - It helps us to understand complex interactions of evens, objects, economic trend, and changes in the society.

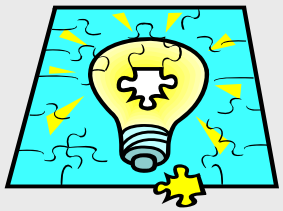


Web

real world

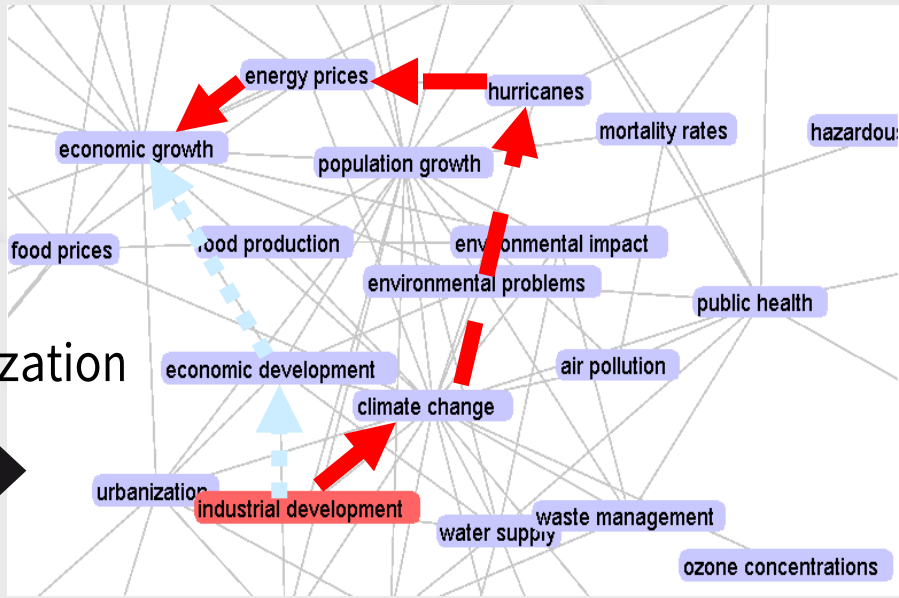
Example of knowledge

Similar knowledge is extracted and is systematized.

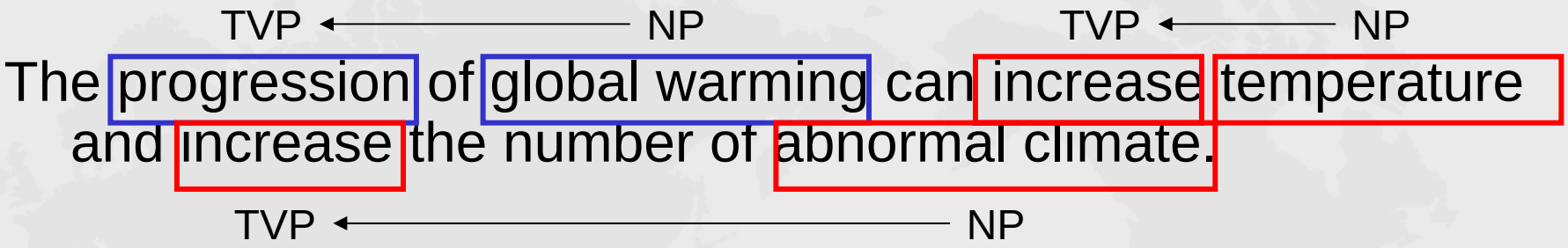


Causality analysis

visualization



Causal network extraction by a natural language processing

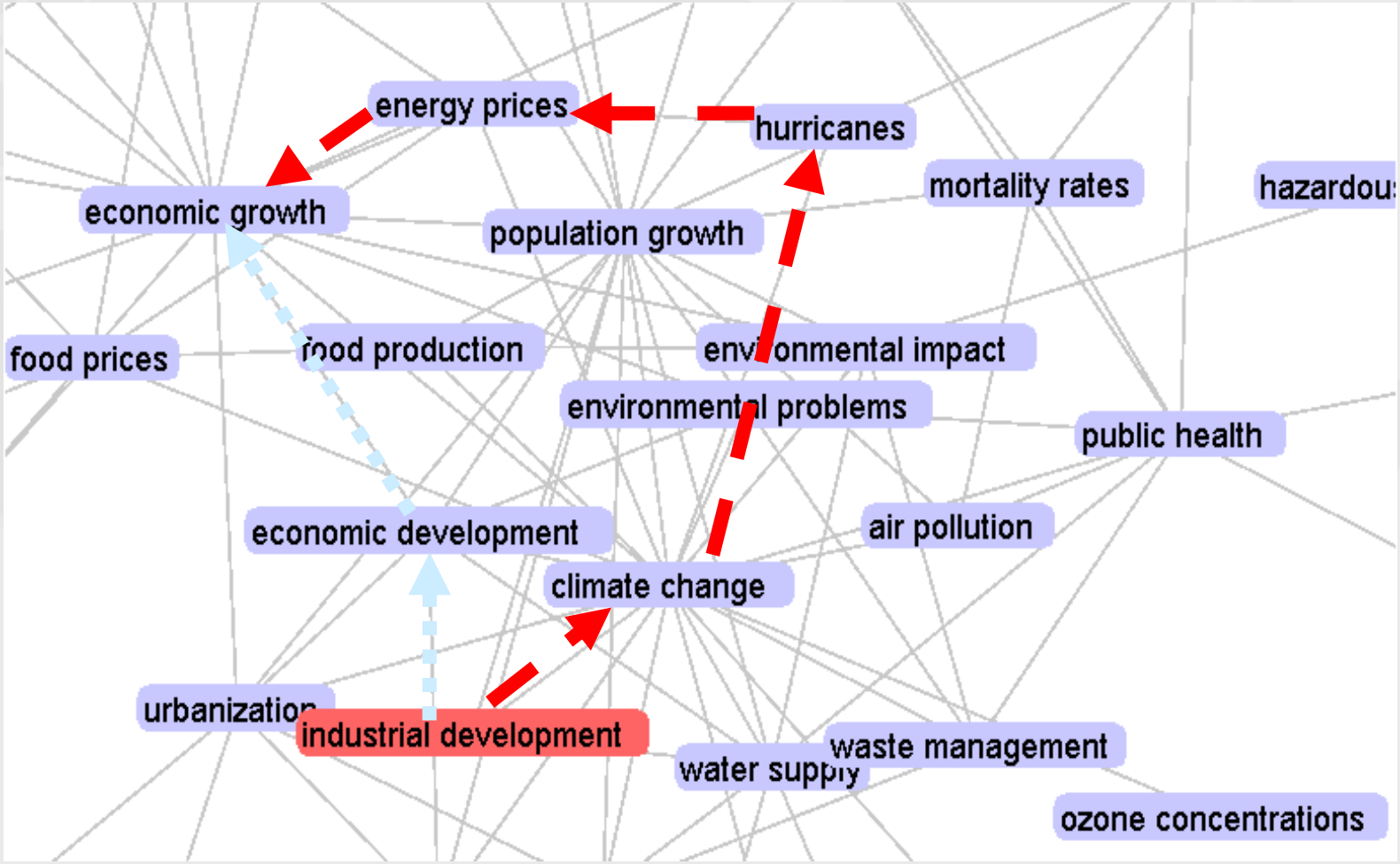


- A fact : a combination of noun phrases (NPs) and trend verbal phrases (TVPs) which represent changes, actions, behaviors and movements of NPs.

- Bootstrapping method for generating a causal network
  - Other causality can be extracted by using the same pair of facts.
    - As global warming progresses, temperature will increase.
  - Other facts can be extracted from sentences including both of representations of the same causality and the same fact.
    - The progress of global warming will cause rise in the sea level.
- Extracted facts are added to the causal network.

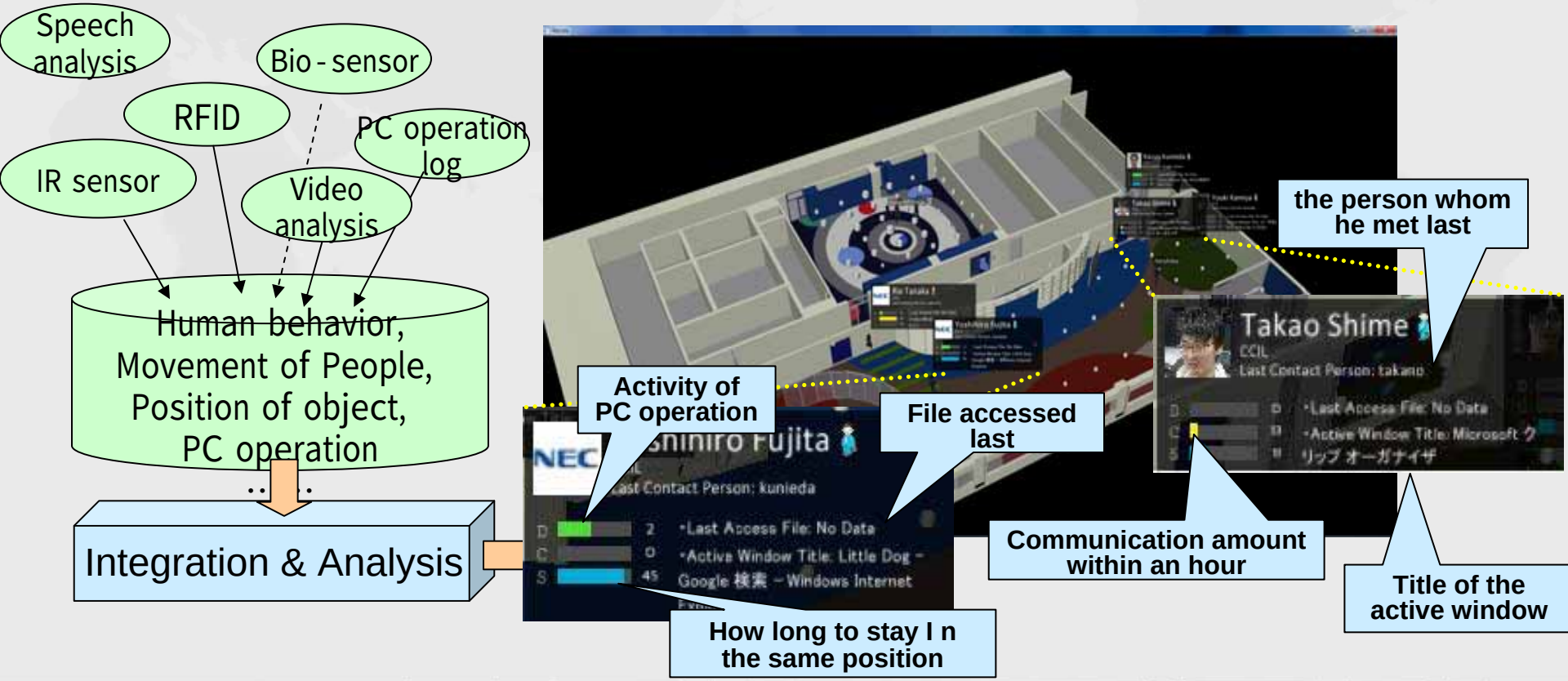
Example of causal network

- We can understand multi-paths between "industrial development" and "economic growth".



Intellectual activity analysis for open co-creation

- **Method to measure intellectual productivity and improve intellectual productivity.**
  - Multi-modal activities of researchers are sensed and analyzed for extracting intellectual productivity of each researcher and idea created from interactions between researchers.



Intellectual activity analysis for open co-creation

- **Method to measure intellectual productivity and improve intellectual producti**

Mental health care in offices

Workflow management

Facilitation of creative communication

analysis

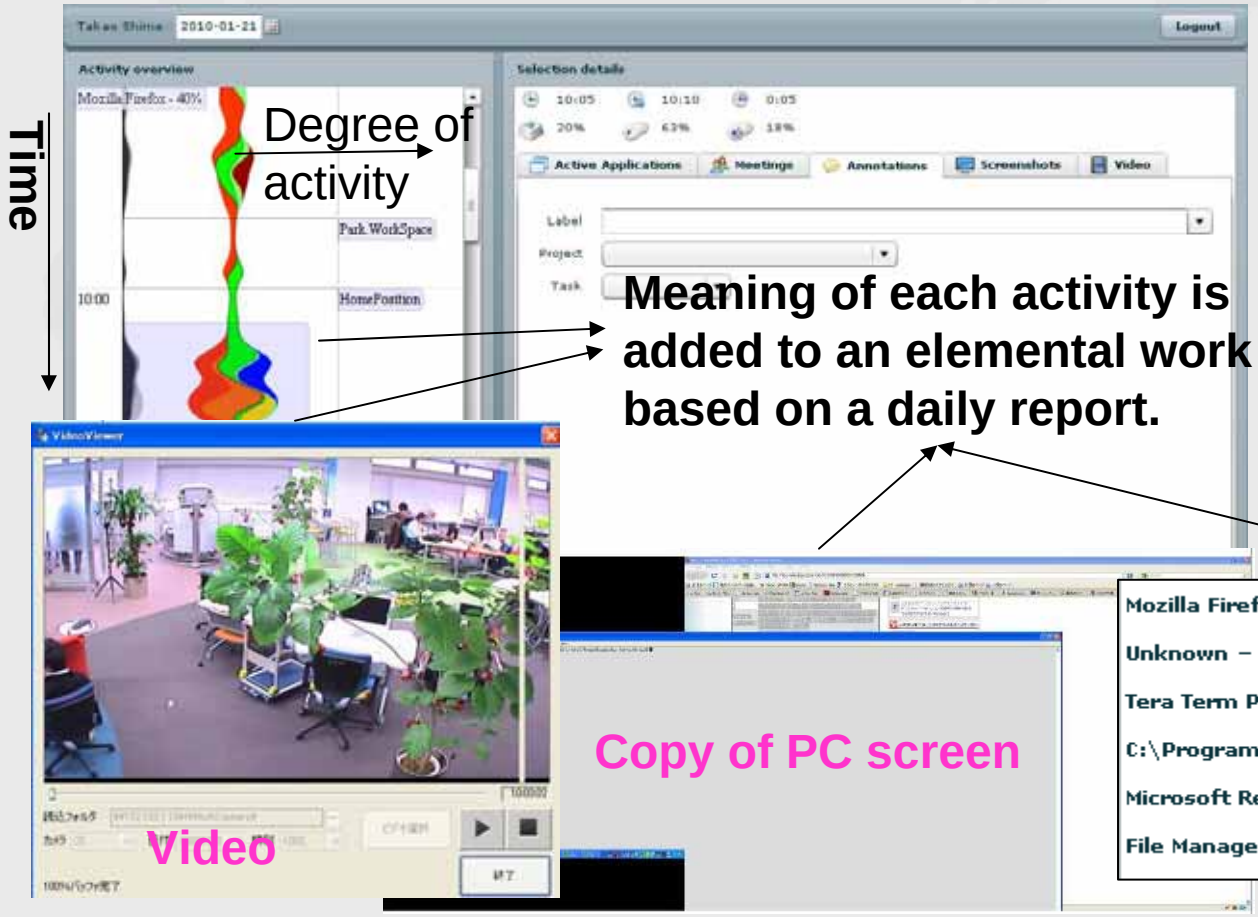
Human behavior,
Movement of People,
Position of object,
PC operation
...

Integration & Analysis

Facilitation of idea creation

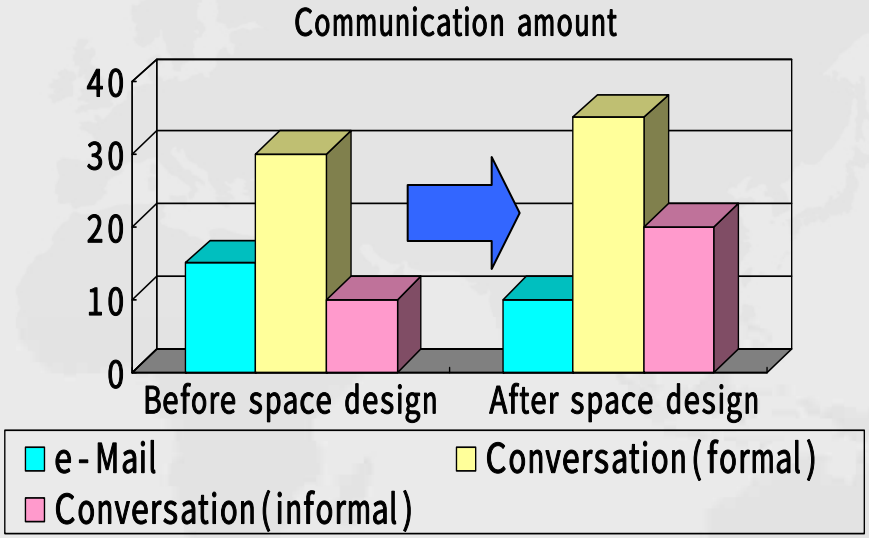
Annotation to sensed data

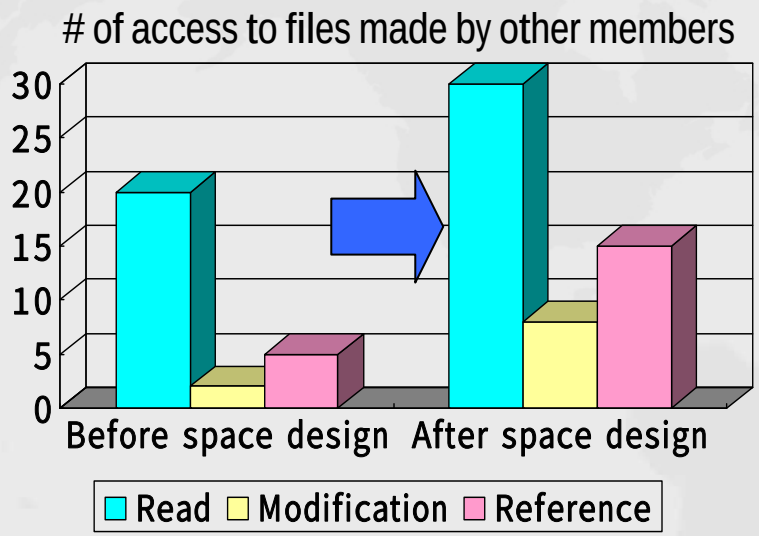
- **Automatic segmentation of workflow generates a set of elemental works, the meaning of which are labeled semi-automatically.**

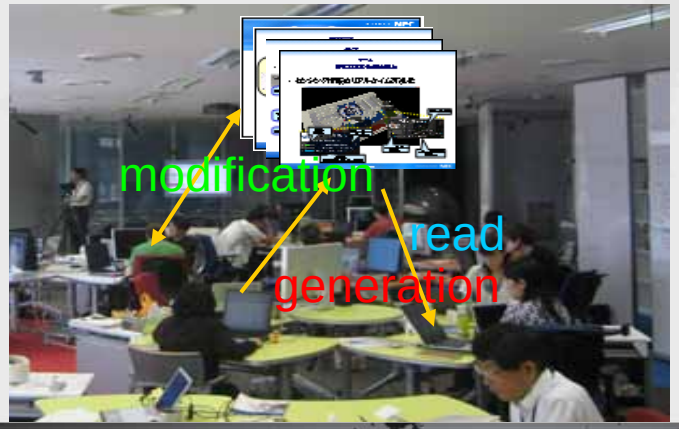


Change of communication mount and knowledge sharing

Office layout may be related to activities of co-creation with mutual communication and file sharing.



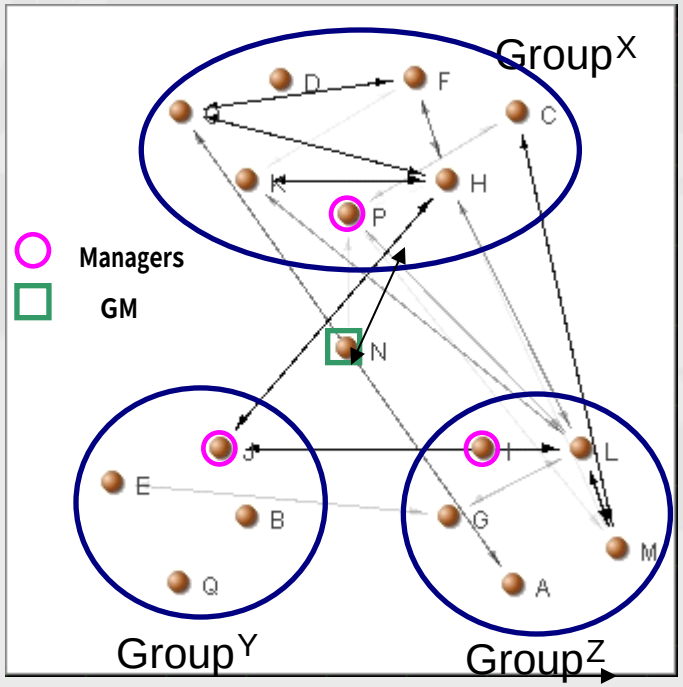




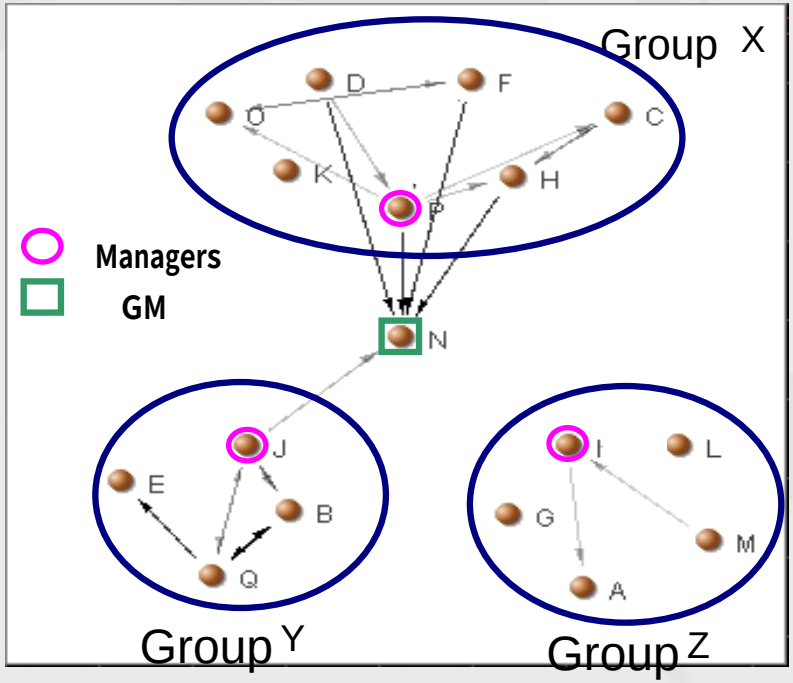
Behavior for communication

- **varies according to way of management and location**

Relaxing area



Direction of information flow within a group

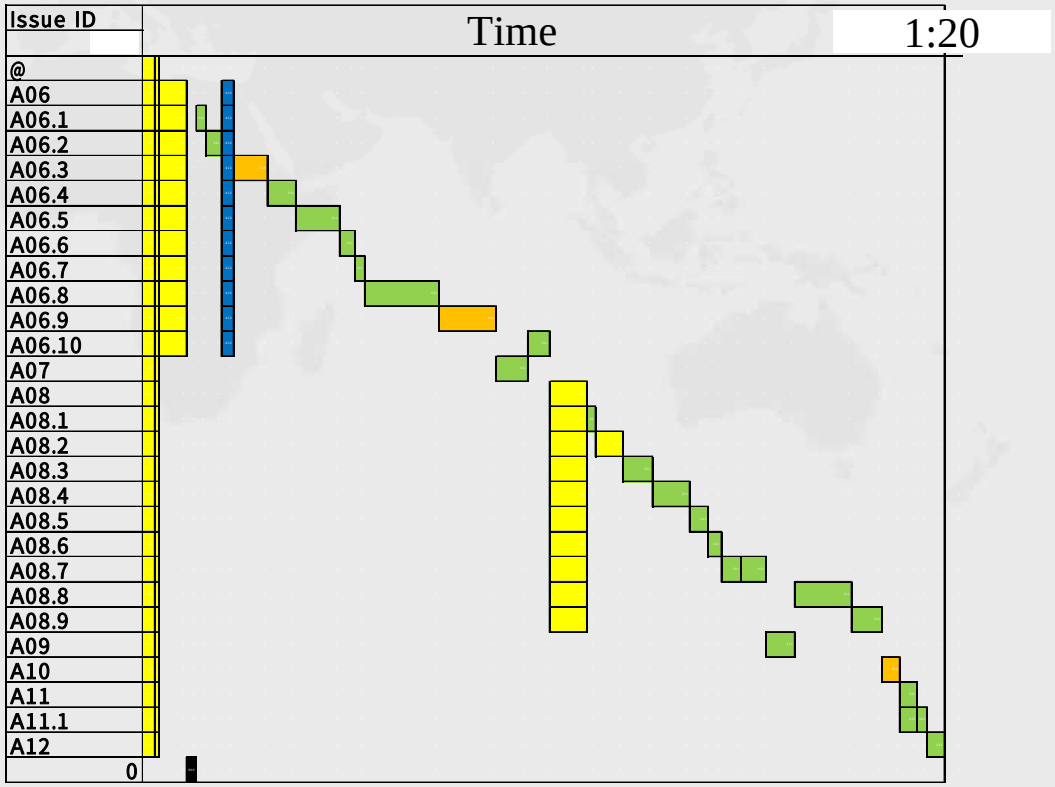


Ratio of communication style	
Within group	**Inter group**
0.474	**0.526**

- Next step:
  How does the way of communication influence intellectual productivity of a research group?

Topic transition in a meeting

- **Management of a meeting influences the efficiency of creativity.**
  - Visualization of topic transition reveals the process to approach the agreements and understandings during a meeting.

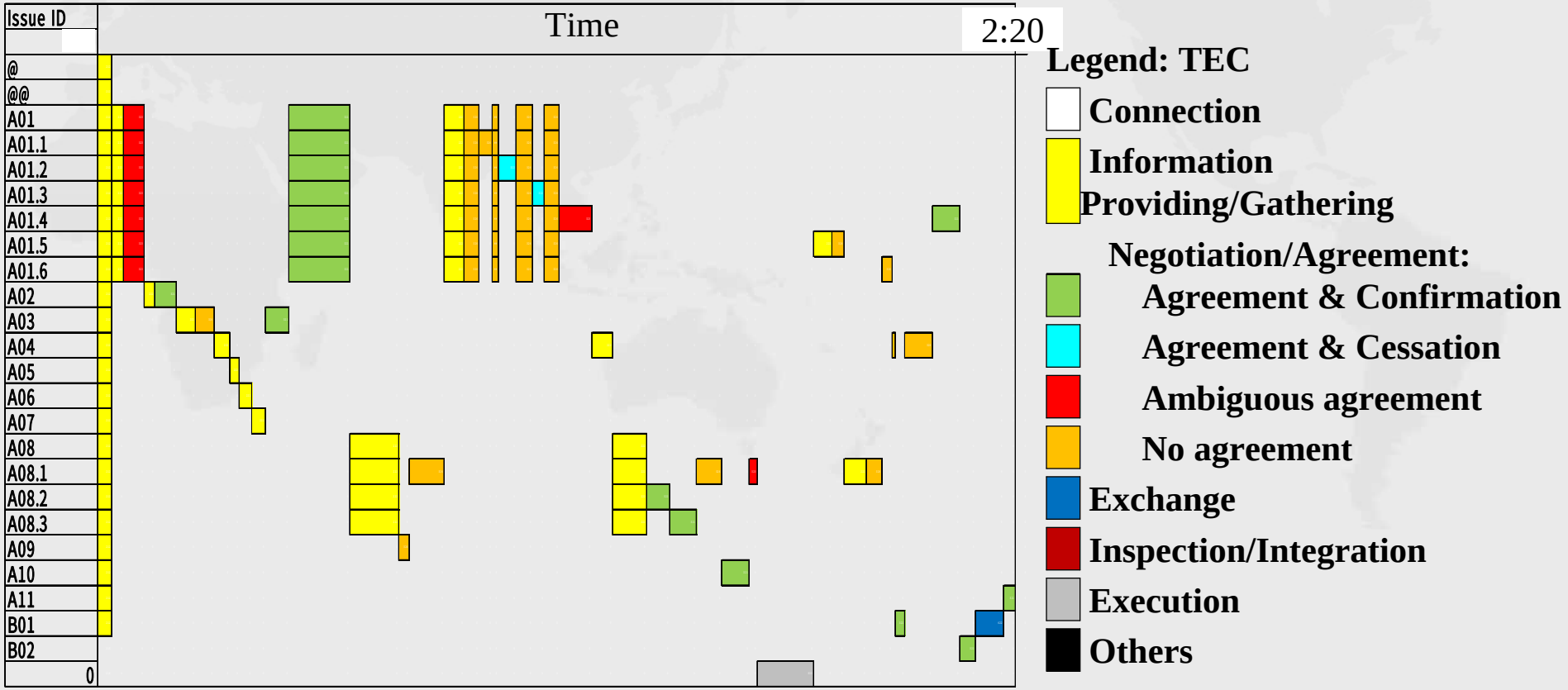


Legend: TEC

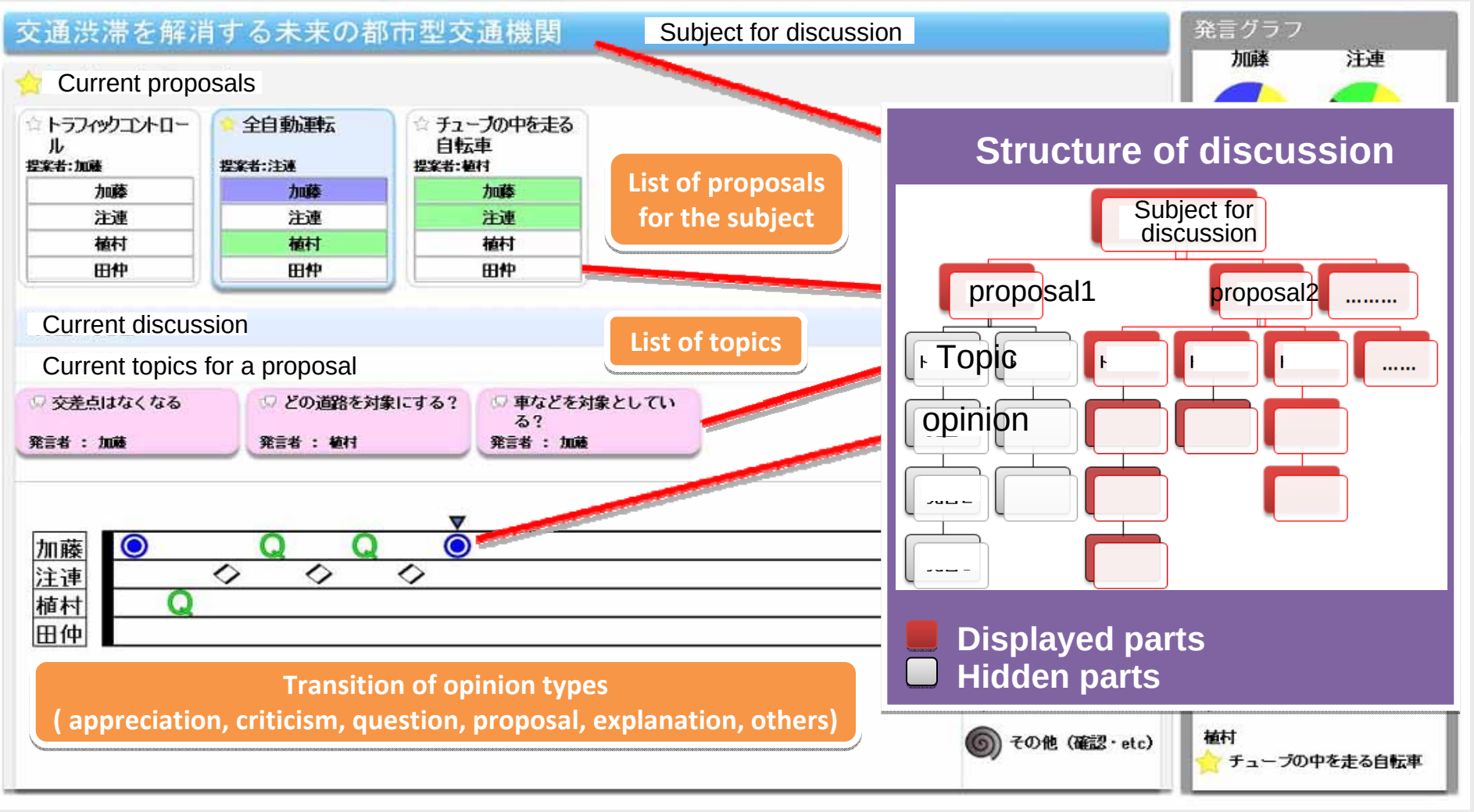
- Connection
- Information Providing/Gathering
- Negotiation/Agreement:
  - Agreement & Confirmation
  - Agreement & Cessation
  - Ambiguous agreement
  - No agreement
- Exchange
- Inspection/Integration
- Execution
- Others

Another topic transition in a meeting

- **There was no agreement at the end of the meeting.**
  - **This process was not good for decision, but might be useful for creation of various ideas.**



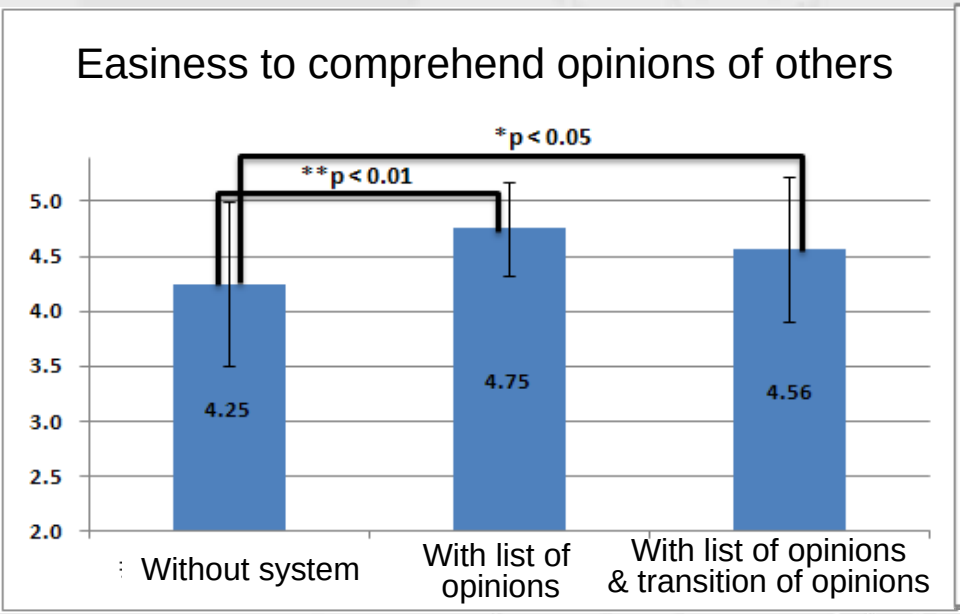
Real time visualization of discussion

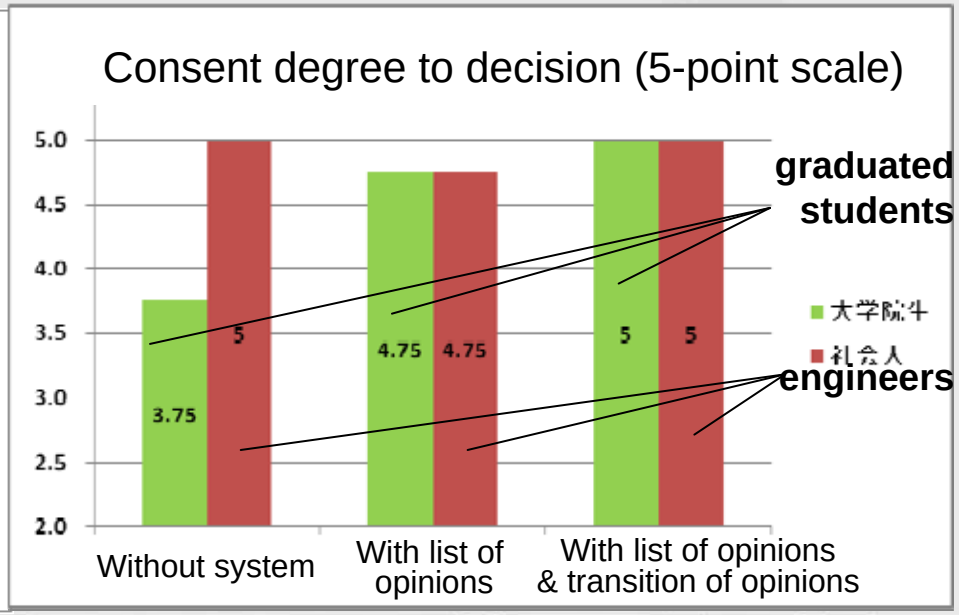


- **It promotes users to clarify their opinions and help them to achieve an agreement.**

Experimental results

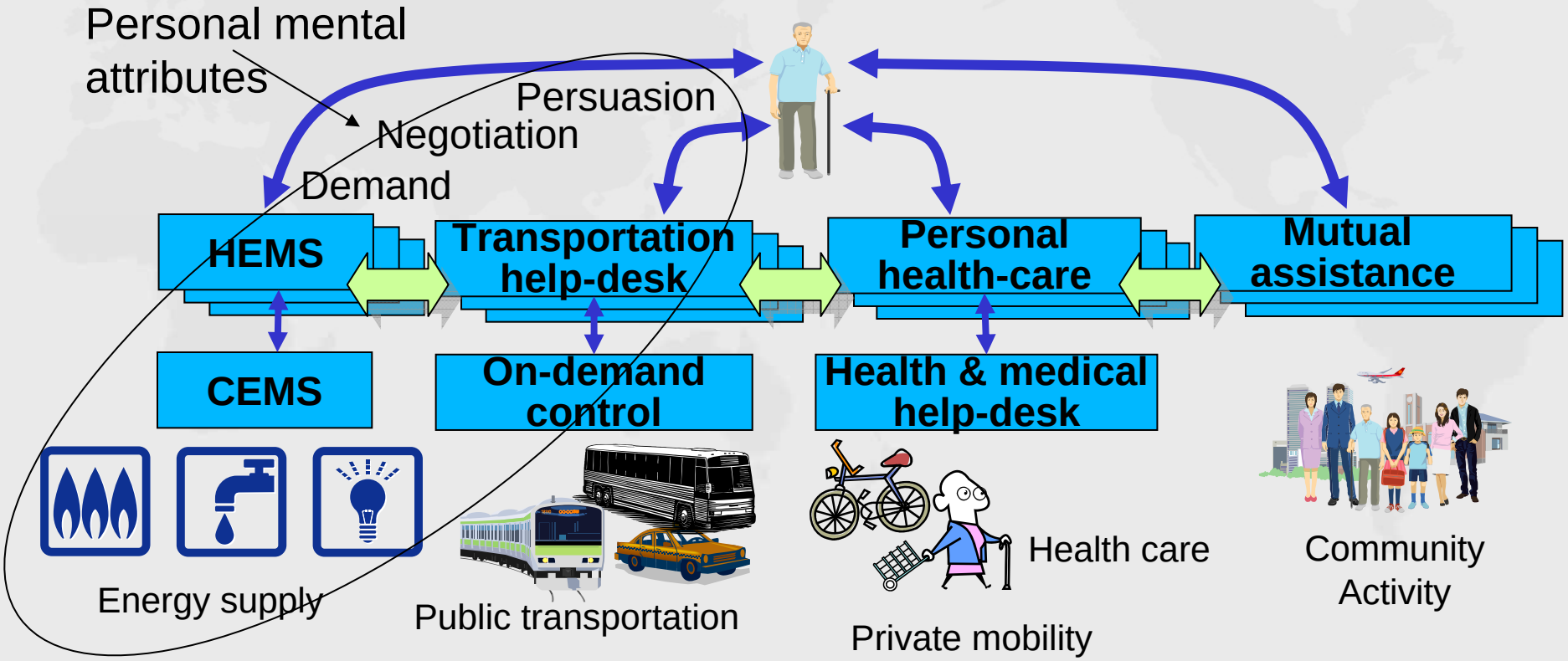
- **Outline of the experiment**
  - **8 groups, 4 subjects for each group**
  - **4 groups: engineers, 4 groups: graduated students**
  - **Session is an hour discussion, 4 sessions by each group**
- **Results**
  - **This system can help people who don't have enough skills for discussion and drive them to produce decision with consent.**





Adaptive activity promotion based on mental attributes

- **Totally activates personal behaviors to contribute the community and increase satisfaction to services.**



- **Balance of resources between demand and supply .**

Mental attributes for ecological behaviors based on psychological investigation

- **classified into five factors by analyzing questionnaires on intention to save energy.**

Increasing activities when seeing status according to types

Positive

Cost conscious

Justice

Awareness of advantage

- Reducing household expense
- Saving money on electricity
- Beneficial to the society

Need for admiration

- Getting compliments from acquaintances
- Able to pride
- Expected by acquaintances

Admiration

Inconvenience

- Troubling acquaintances
- Being embarrassed
- Getting untrusted

Sense of impotence

- Individual efforts cannot influence the society
- No interest in energy saving by other people

Burden

- Time consuming
- Stressful
- Mental fatigue

Negative

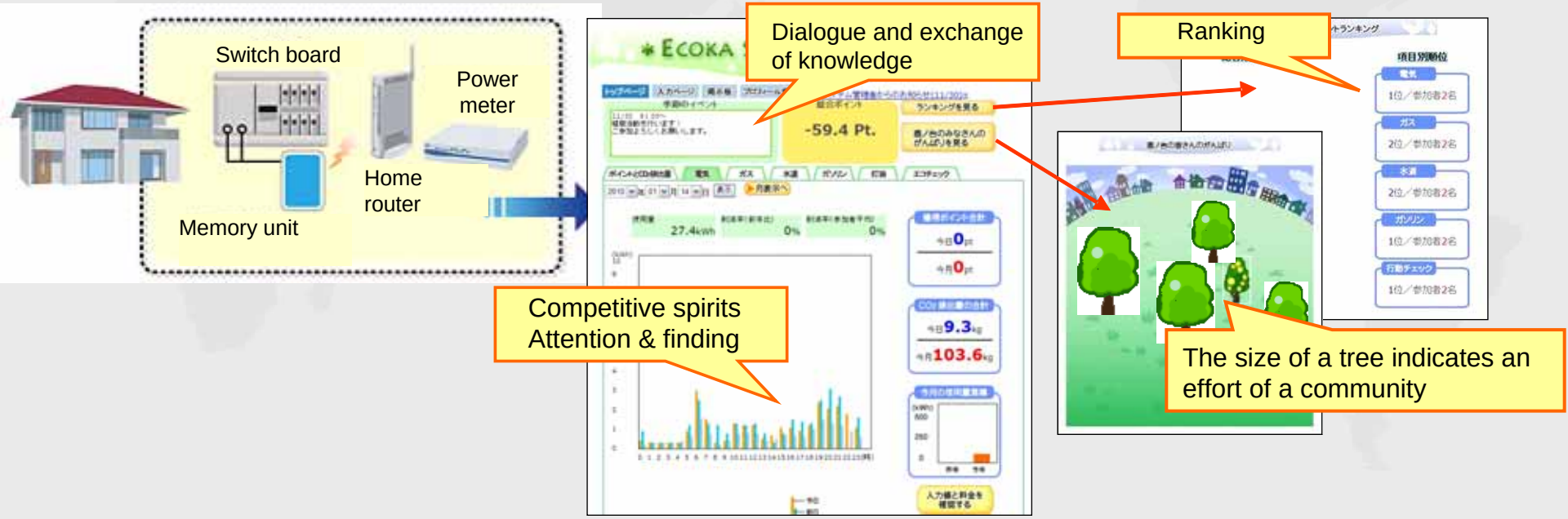
Competitiveness

TIPS for action

Motivating actions by showing tips and encouraging competitiveness

Promotion of energy saving activities in a community

- **Visualization of community activities for energy saving**
- **Adaptive situation visualization depending on individual attribute type to motivate active ecological behaviors**
  - **For the earth, for economy, for health, for fashion**



These technologies will be applied to traffic behavior, community activity, motivation for health, and business activity.

Daily life assistance for aged people

- **Networked ambient agents activate aged people who live alone and make them participate actively in local communities.**

Cross-cultural communication

Education

Tele-education
(Mediation of communication, Assisting lectures by aged people)

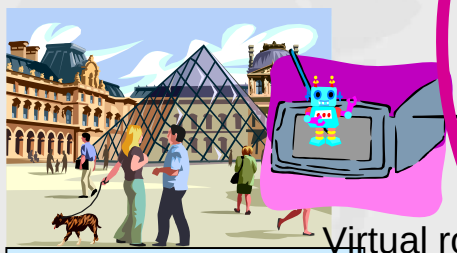
Unconscious

Sensors embedded in environment (urinalysis, blood pressure)

Medical Nursing care

Tele-medicine
(consulting doctors)

Visible/Virtual types

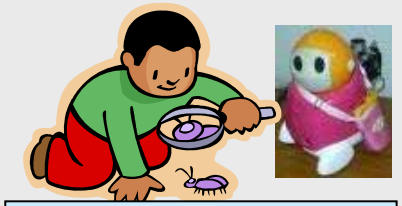


Virtual robot

Travel navigation

Sight seeing navigated by virtual robot

Wellness trainer
(training robot, communication mediation)



Visible type

Nature navigation

Visible

Unconscious

Wearable sensors
(Heart beat, accelerometer)

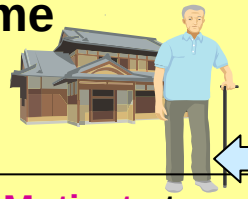
Wellness trainer/Rehabilitation

Daily life assistance for aged people

The system acquires attributes and concerns of each person and modifies scenarios of interaction to promote him/her for participating in group activities.

From a set of interactions, the system updates his interests, his type of attributes, and current emotion.

At home



Motivate to meet with others

Local Organizations
Event Information etc.

Connected Services via Network Robots

Online

Maintain Contacts

Medics

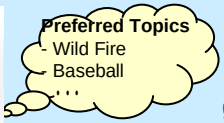
Keep Relationships

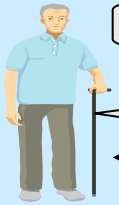
Friends

Family in Distance

Recommend to attend events

Build a Relationship

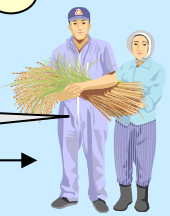




Fire in CA..

I was there once before ..

Scarily !

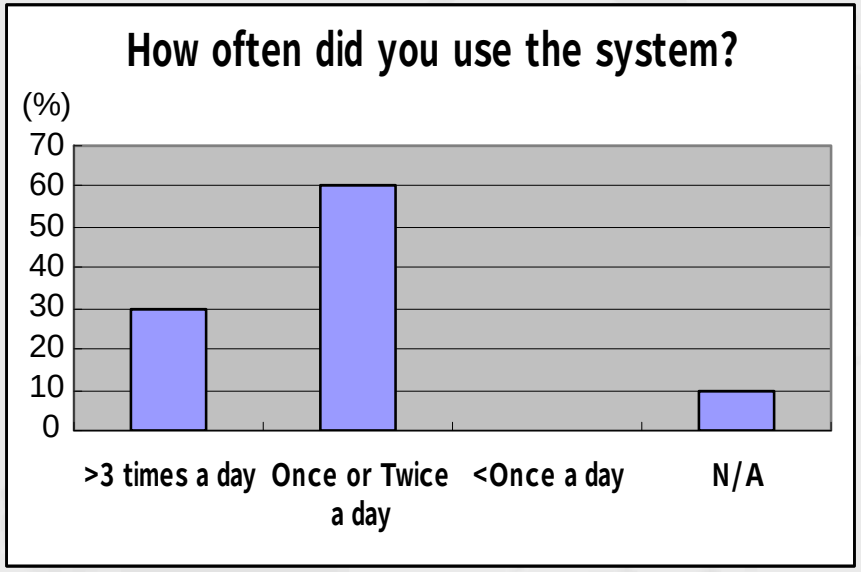


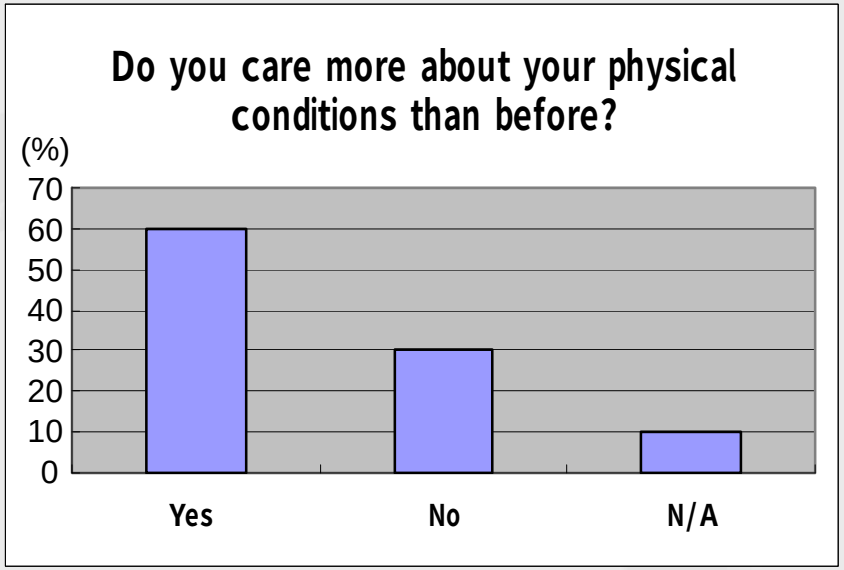
Provide suitable topics to participants

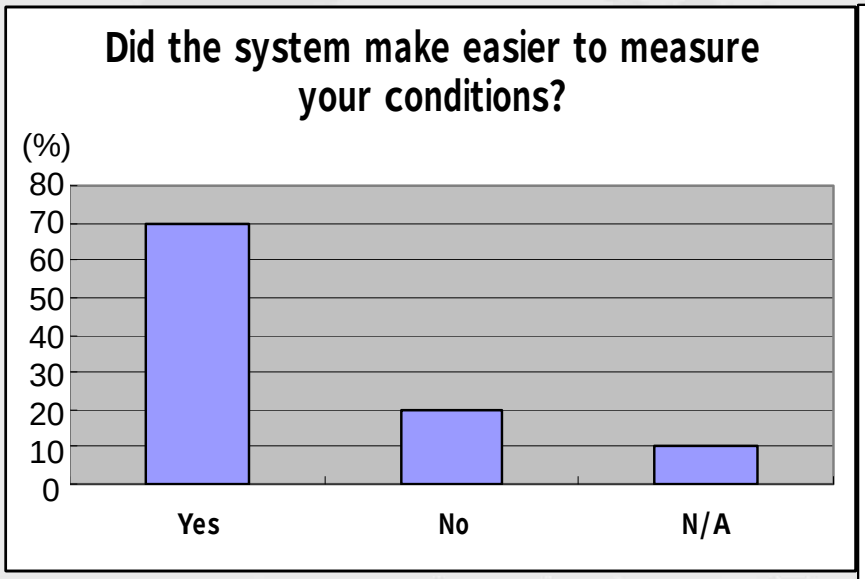
Mediate Conversation

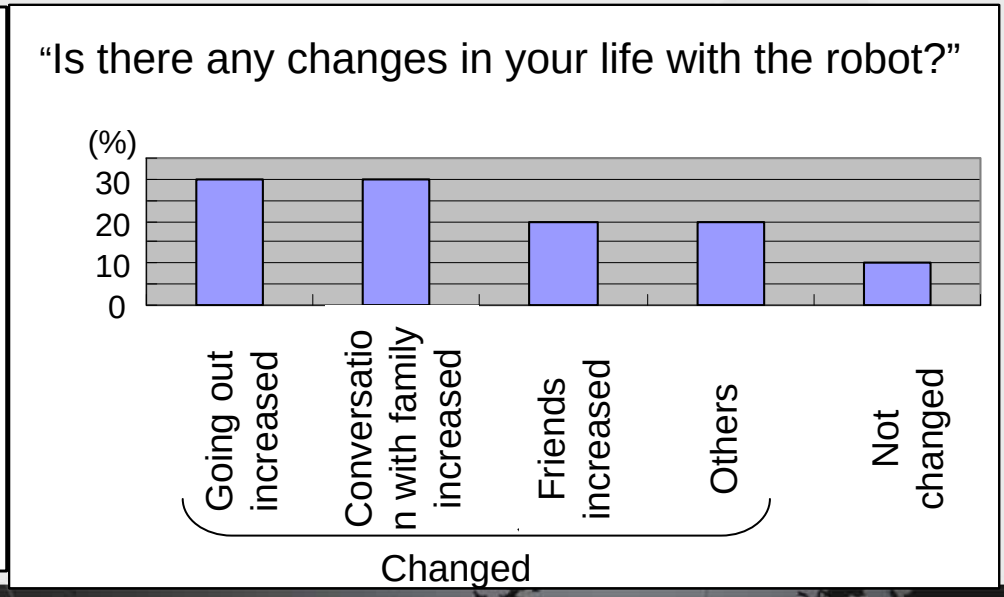
meeting room in a village

Experimental results









Summary

- **Symbiotic system and symbiotic technology: fusion of socio-technology and scientific technology.**
  - **Intellectual productivity and creativity of open co-creation**
    - **This idea was tested in communication in an office and in management of meetings**
  - **Adaptive activity promotion based on mental attributes**
    - **This idea was tested in promotion of ecological behaviors and activation of elderly community.**
- **Next step**
  - **We are testing them in a larger community.**
- **Future work**
  - **The way to use mental attributes for other applications**
  - **The way to manage intellectual productivity**
  - **“Quality of life” depends on cultures and countries**

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