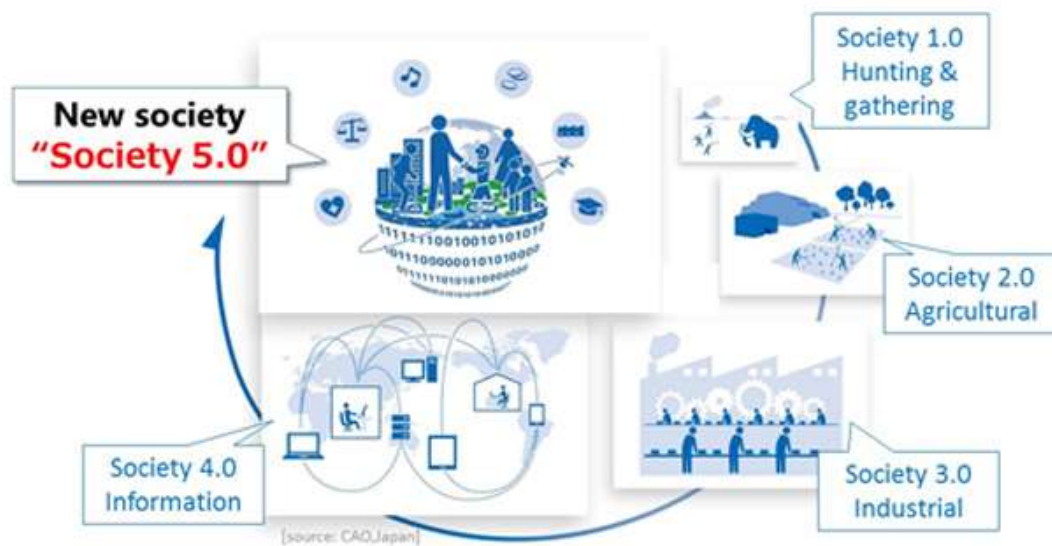


# Society 5.0, A Collaboration between Human and Machine Intelligences

Dr. Seiichi SHIN  
Professor Emeritus  
University of Electro-Communications



# Society 5.0



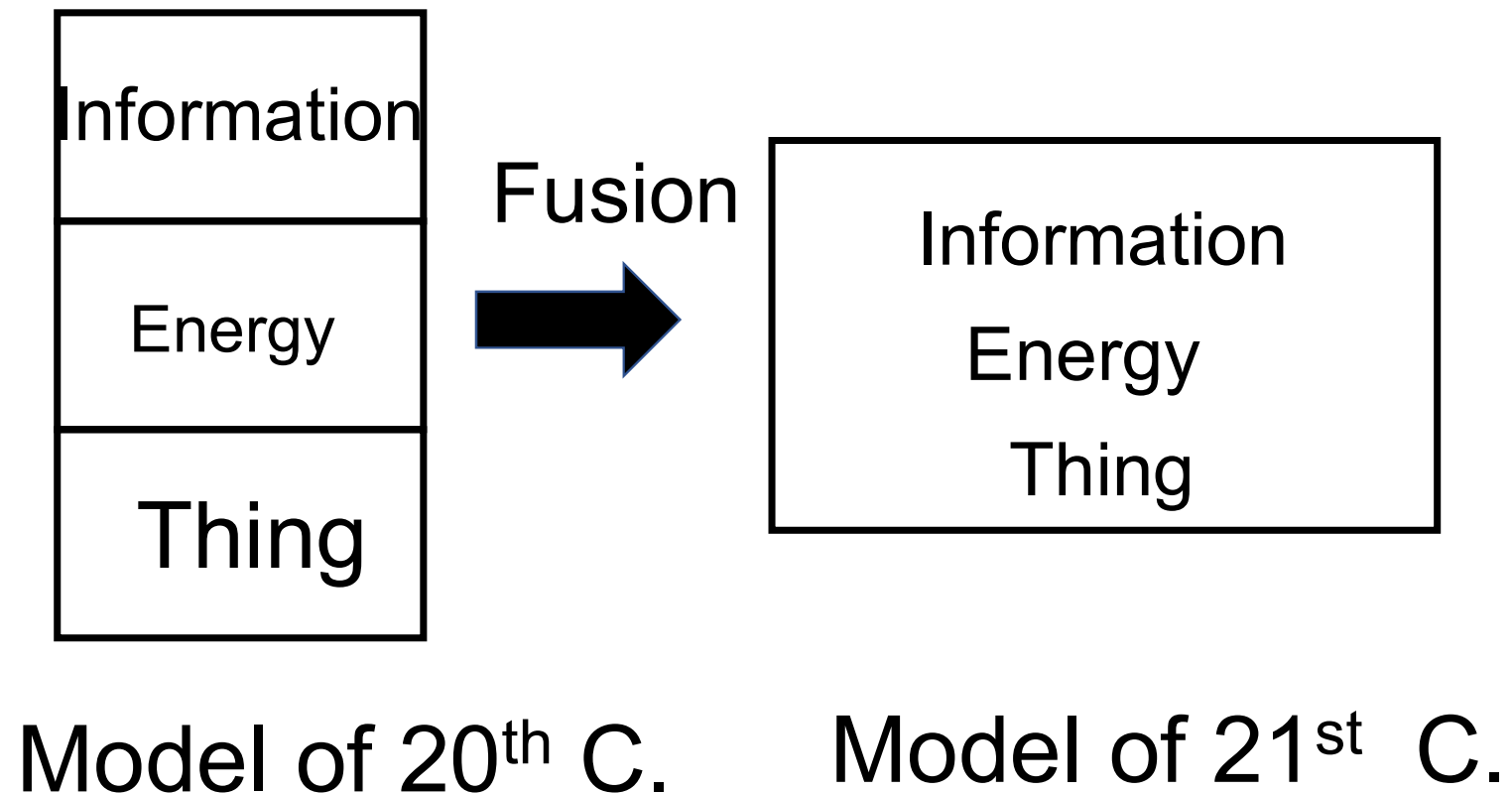
## What is Society 5.0?

One definition: "A human-centered society that balances economic advancement with the resolution of social problems by a system that highly integrates cyberspace and physical space."

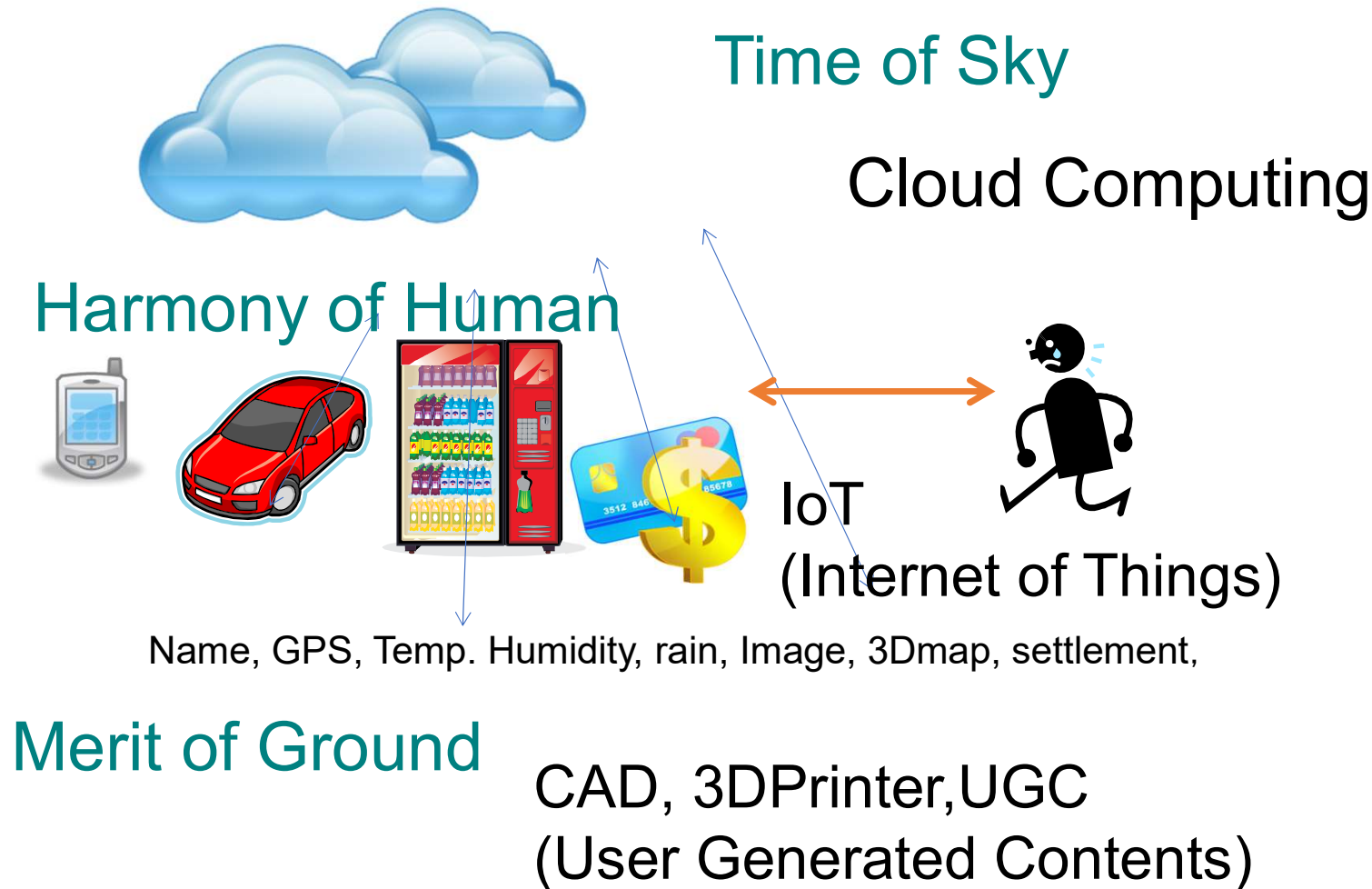
Society 5.0 was proposed in **the 5th Science and Technology Basic Plan** as a future society that Japan should aspire to. It follows the hunting society (Society 1.0), agricultural society (Society 2.0), industrial society (Society 3.0), and information society (Society 4.0).



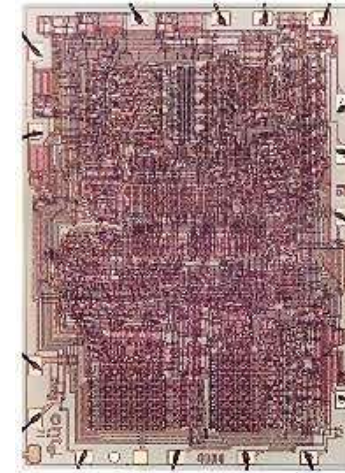
# From 20th Century to 21st



# Cyber Physical System



# 1971: 4004 Micro Processor



[http://www.intel.co.jp/jp/personal/museum/hof/?iid=jpsiteindex+personal\\_museum\\_hof&](http://www.intel.co.jp/jp/personal/museum/hof/?iid=jpsiteindex+personal_museum_hof&)



# Atomic Reactor Monju

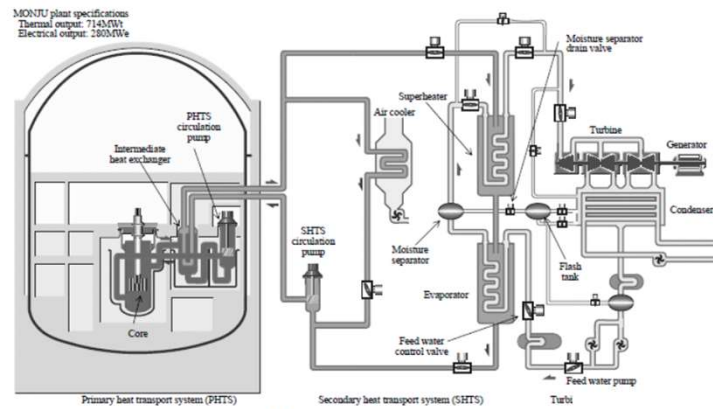
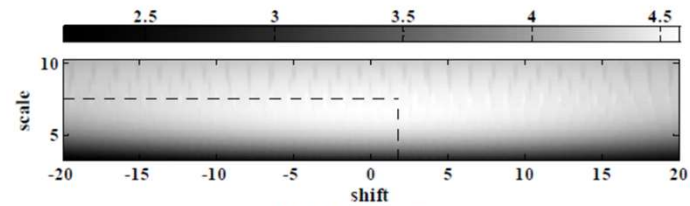
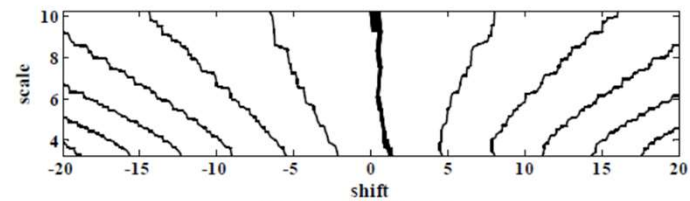


Fig. 2-1 MONJU main heat transport system



(a) Modulus of coefficient



(b) Angle of coefficient



# Day Fuzzy Washing Machine



1988

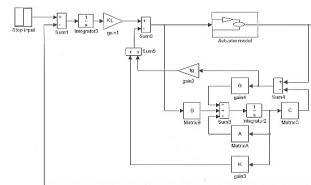
Torque Sensor(Amount of  
Cloth)

Optical Sensor (Washing Status)

<http://national.jp/labo/history/sentaku.html>



# Application of Two Degree Of Freedom Control



連続系サーボ シミュレーションソフト

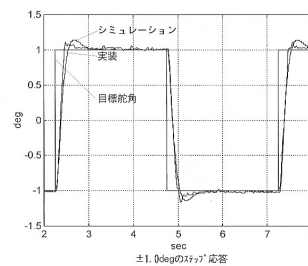
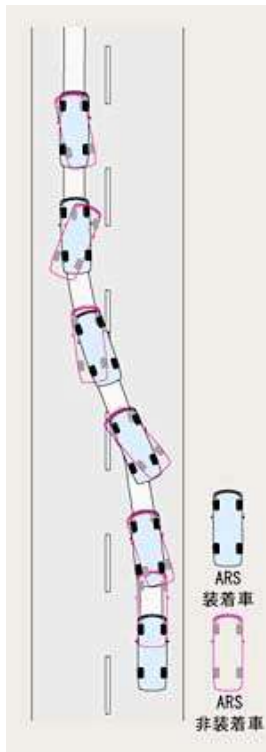
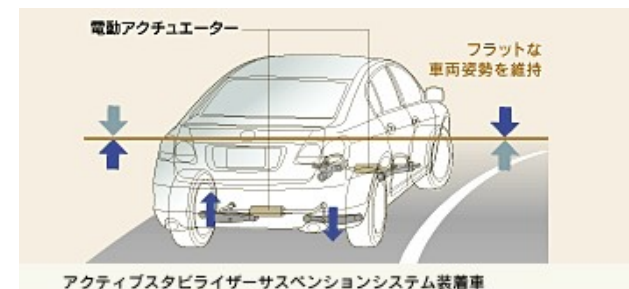
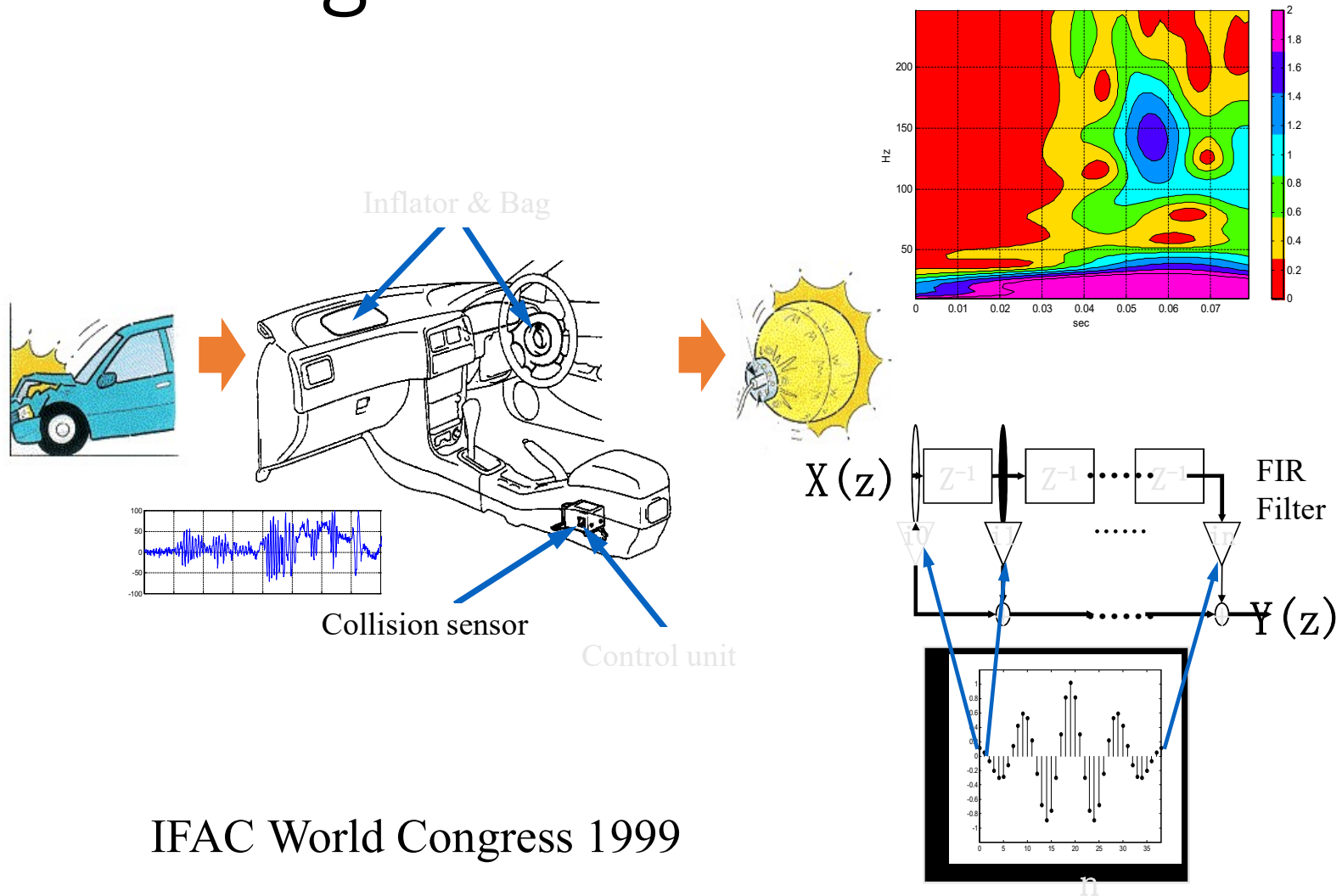


图 1-7





# Air Bag



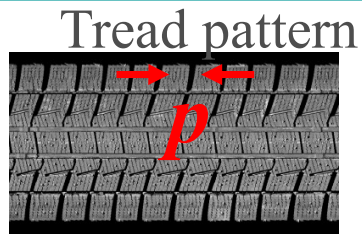
IFAC World Congress 1999



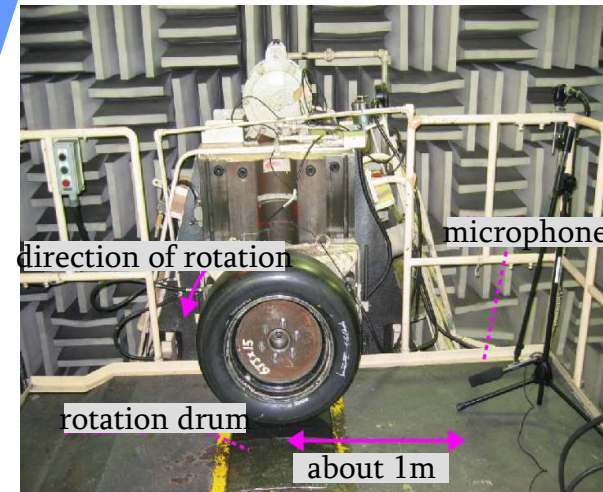
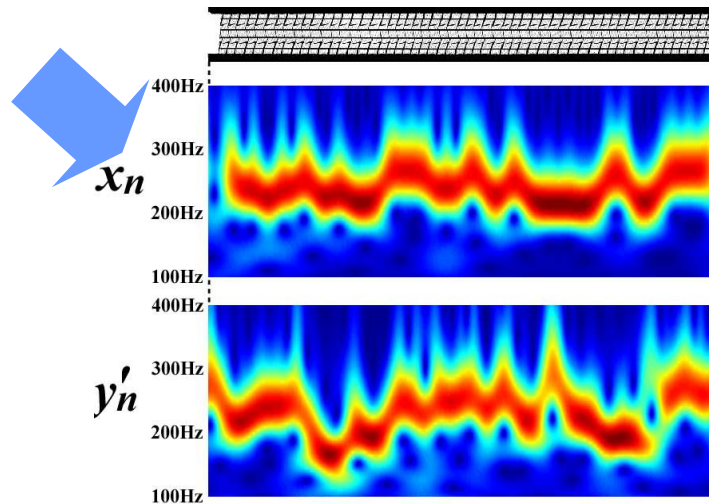
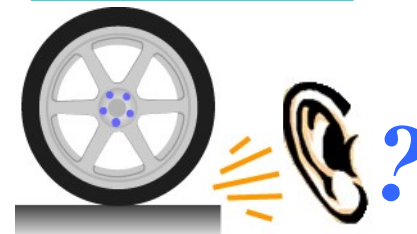
# Estimation of Tire

Pitch variation

Tire sound



Relation



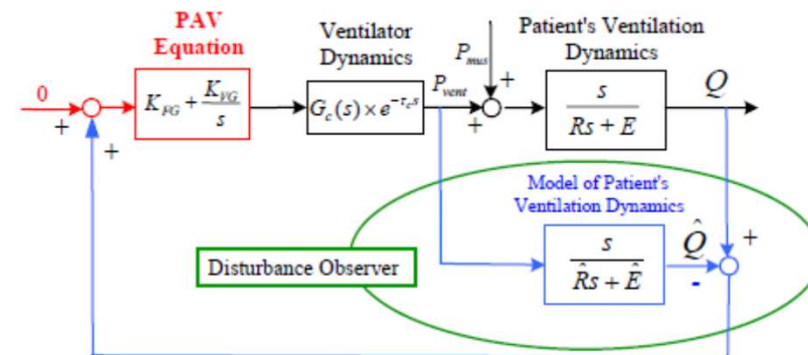
# Ventilator S S V



SSV-200



操作パネル画面



<http://www.ks>

$$Q = (P_{mus} + P_{vent}) \frac{s}{Rs + E}$$

$$\hat{Q} = \frac{s}{\hat{R}s + \hat{E}} \times P_{vent}$$

$$\begin{matrix} \hat{R} = R, \\ \hat{E} = E \end{matrix} \rightarrow \hat{P}_{mus} = \left( \hat{R} + \frac{\hat{E}}{s} \right) (Q - \hat{Q}) \rightarrow P_{mus} \text{ can be estimated with the observer}$$



# Active Guide for Elevator

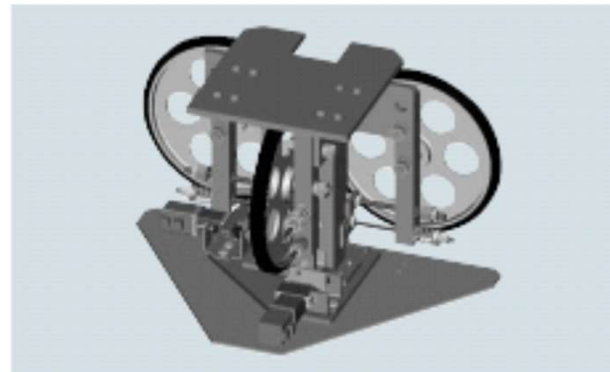


図5 アクティブガイド装置の構成

乗りかご内の加速度をフィードバックして、ガイド装置のローラ押し付け力を制御するアクティブガイド装置の構成を示す。

## 3.5 走行性能

大容量・超高速エレベーターの開発において、実際に400 mを超える試験設備による評価試験は困難である。

日立グループは、従来の超高速エレベーター開発の中でエレベーターの乗り心地をシミュレートする技術を確立した。

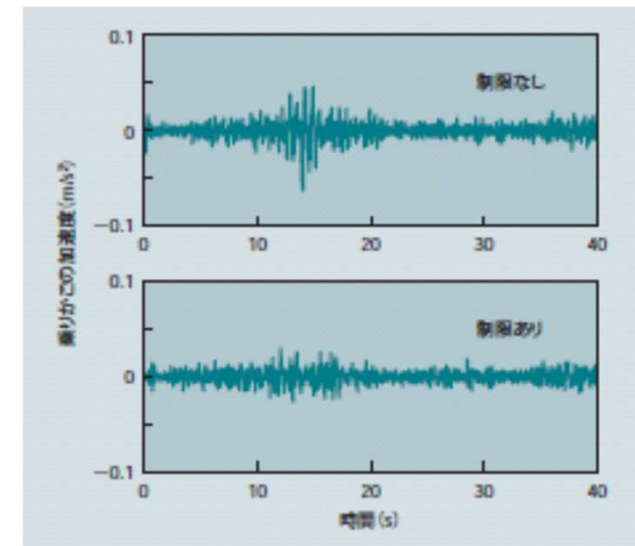


図6 地上走行試験装置での乗りかごの横振動加速度

速度480 m/minのエレベーターにおける、乗りかご内の横振動を半減できることを、地上走行試験装置で確認した。

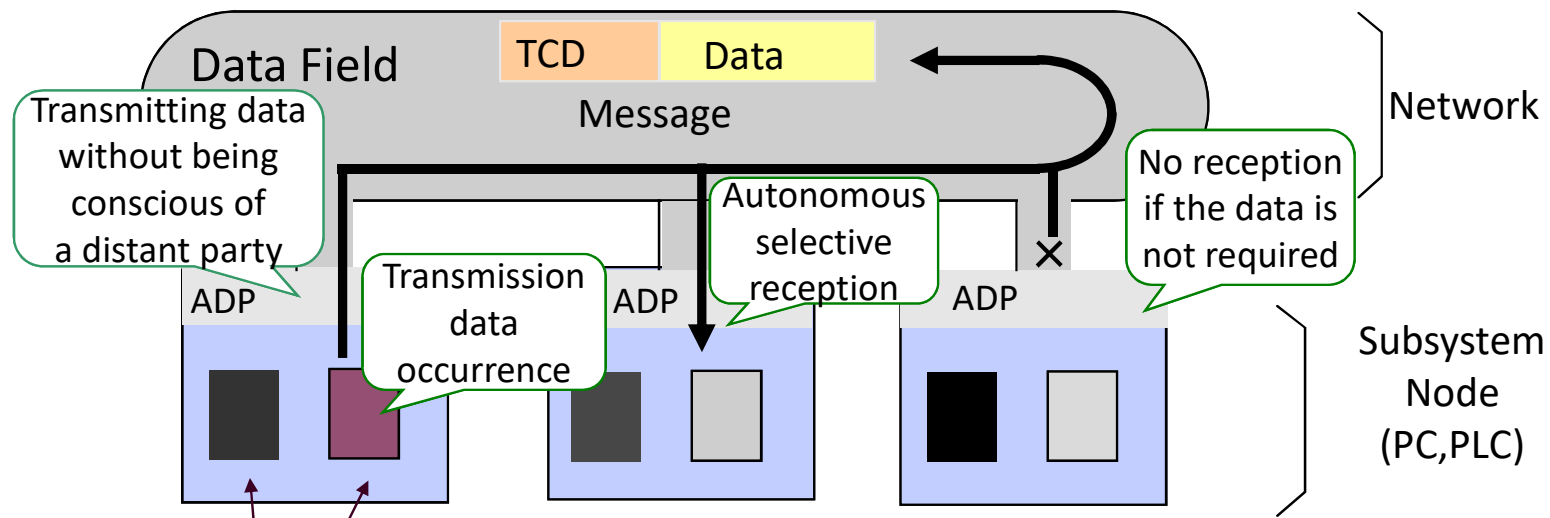
執筆者紹介

2006/12/20



# Mechanism of ADS-net

## ISO 15745



Application  
Program

All nodes function as a server and client.  
(All Client All Server)

Reception / no reception is determined by TCD.

TCD : Transaction Code ( Identifier of data )

ADP : Autonomous Decentralization Protocol





# Nine Test beds in CSS-base 6



**Assembly Plant**



**Sewage Plant**

■ Research, Development, Promotion, Training, Exercise, etc.



**Gas Plant**



**Building Plant**



**Chemical Plant**



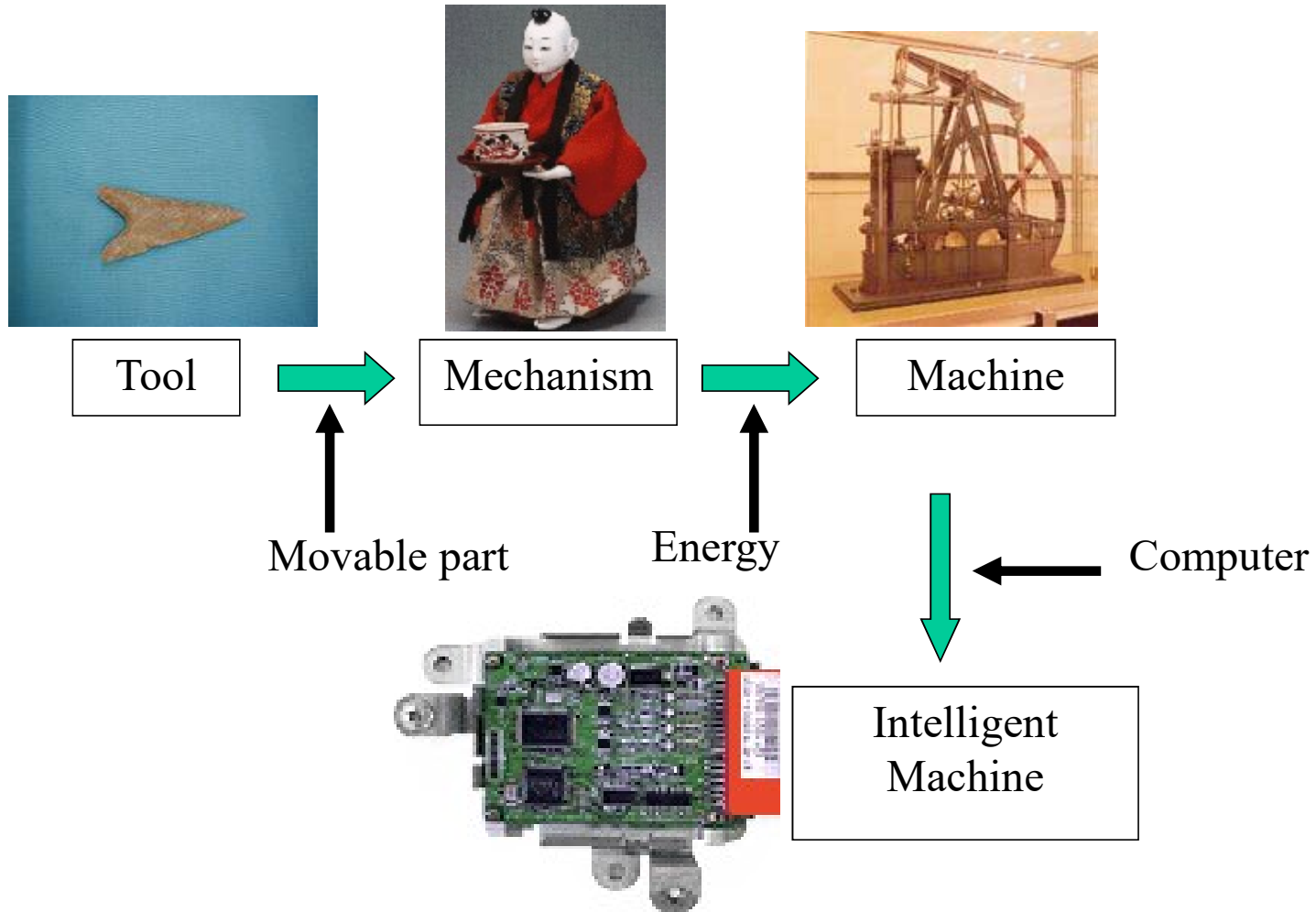
**Smart City)**



**Electric Power Plant**

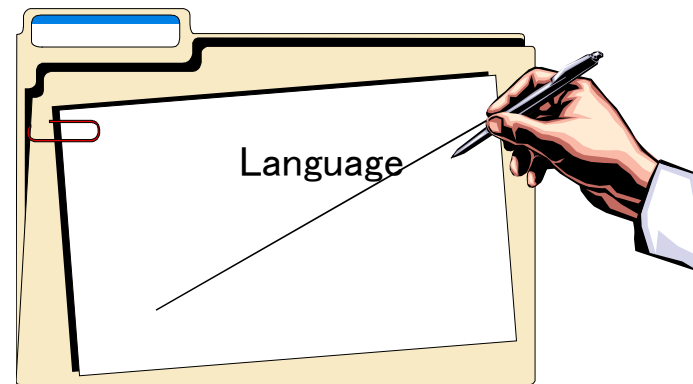
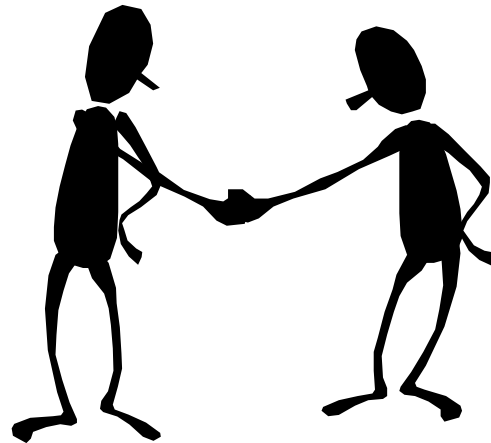


# Progress of Machines



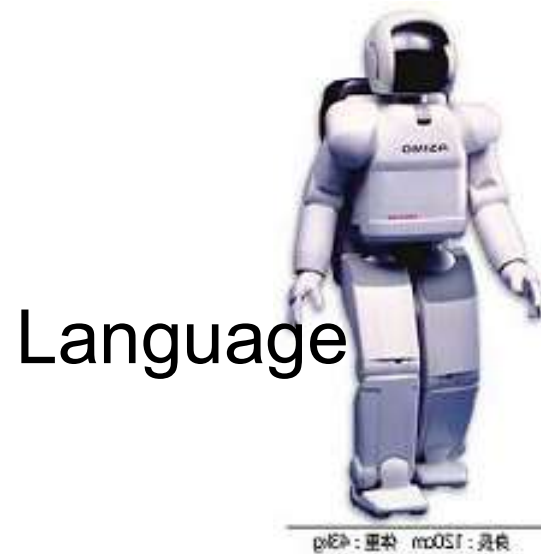
# Intelligence is Language

Language





# Machines got Language.



Language



Language

Programs, Storage and Communication



# Machines overcome Humans.

## Ability of Machines

Information Technology =

- Wide Band (Gbps)
- Mass Storage (TB)
- High Speed (GIPS)
- Action  $\mu$  sec.
- Speed, 300km/h

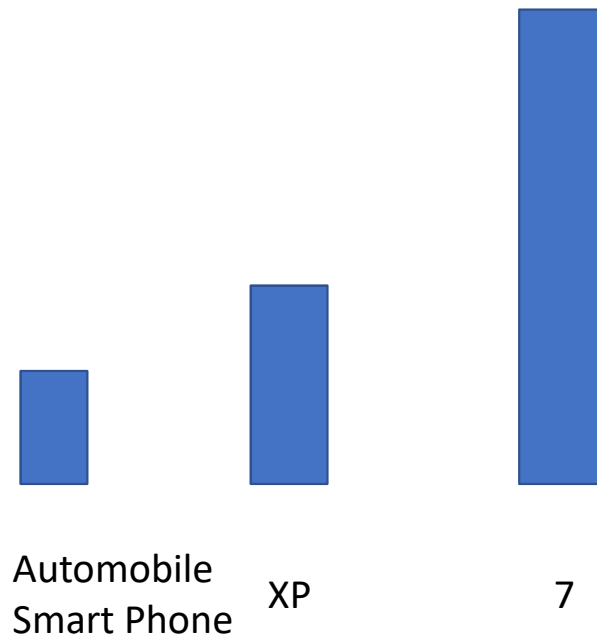
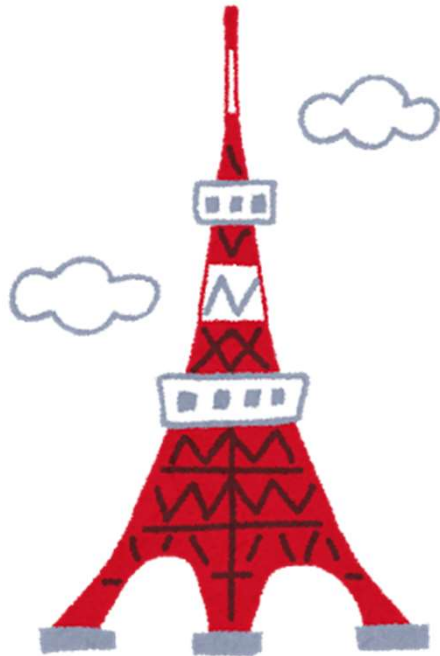
## Ability of Humans

- Logic, Voice, 300W/M, 5W/S, 80bps(16bit /W)
- Image, Resolution  $1000 \times 1000$
- Movie 30F/S, 2Mbps
- Action, Response 0.1 Sec
- Speed, 10m/S



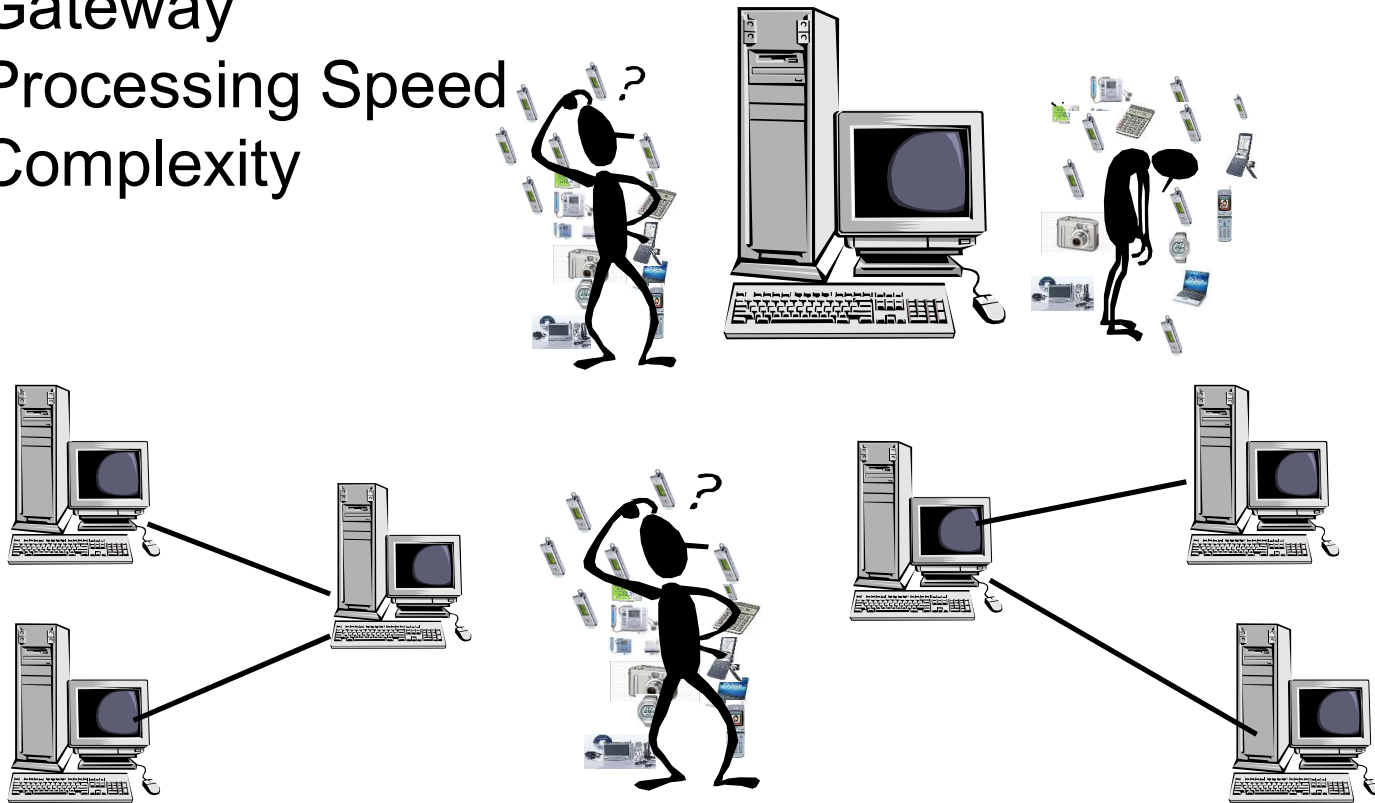
# Amount of Software

Windows 7 consists of more than 100 million lines.

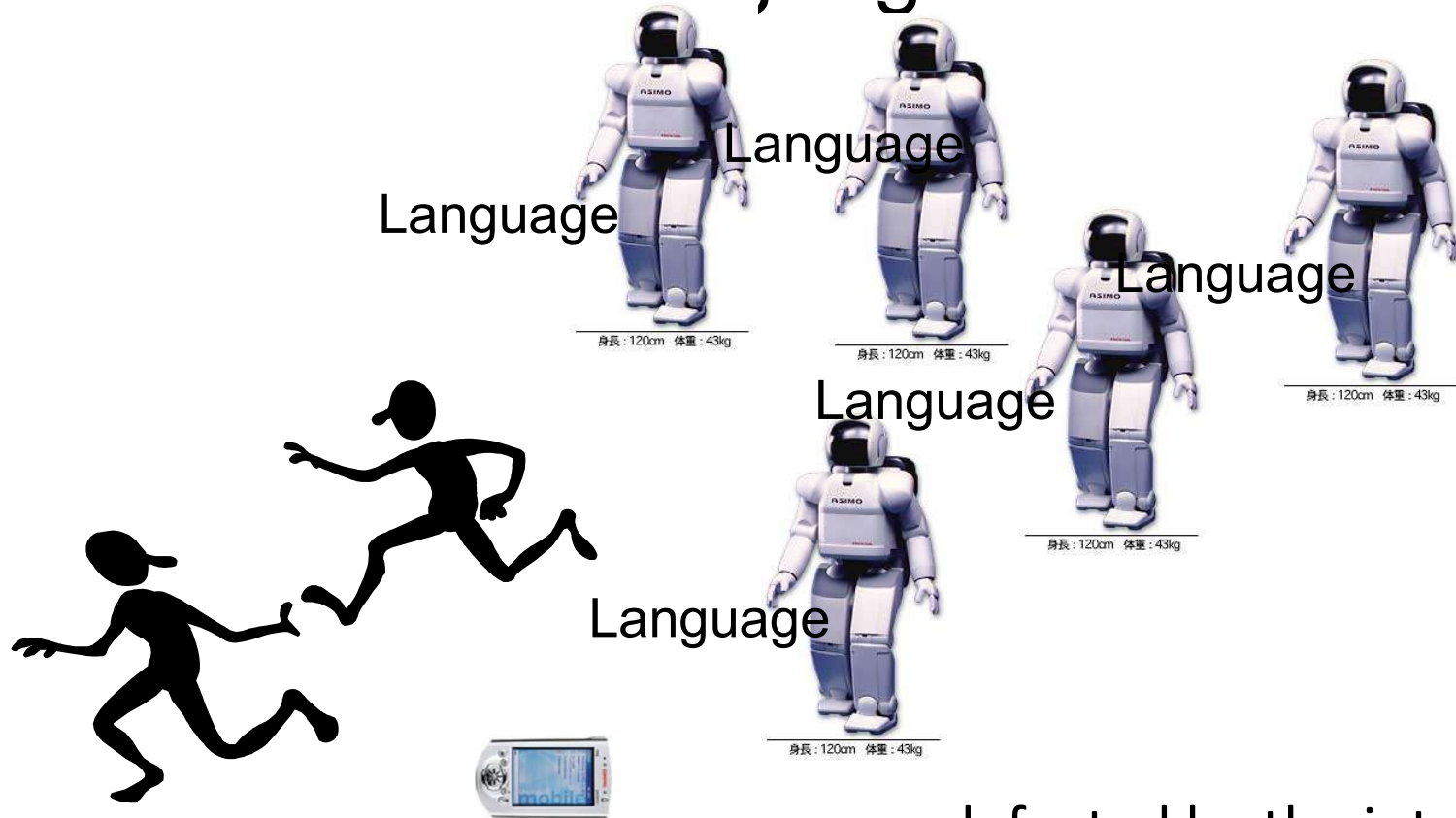


# Humans are divided by Machines Machines are divided by Humans

- bit
- Gateway
- Processing Speed
- Complexity

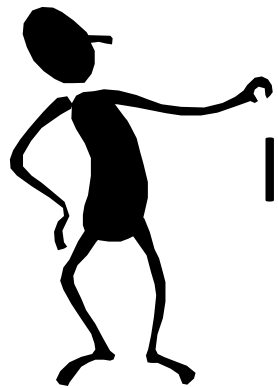


# Human face to machine with language.



defeated by the intelligent machine

# Frankenstein: or The Modern Prometheus



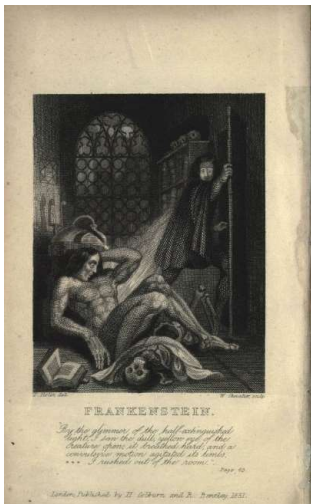
Intelligence



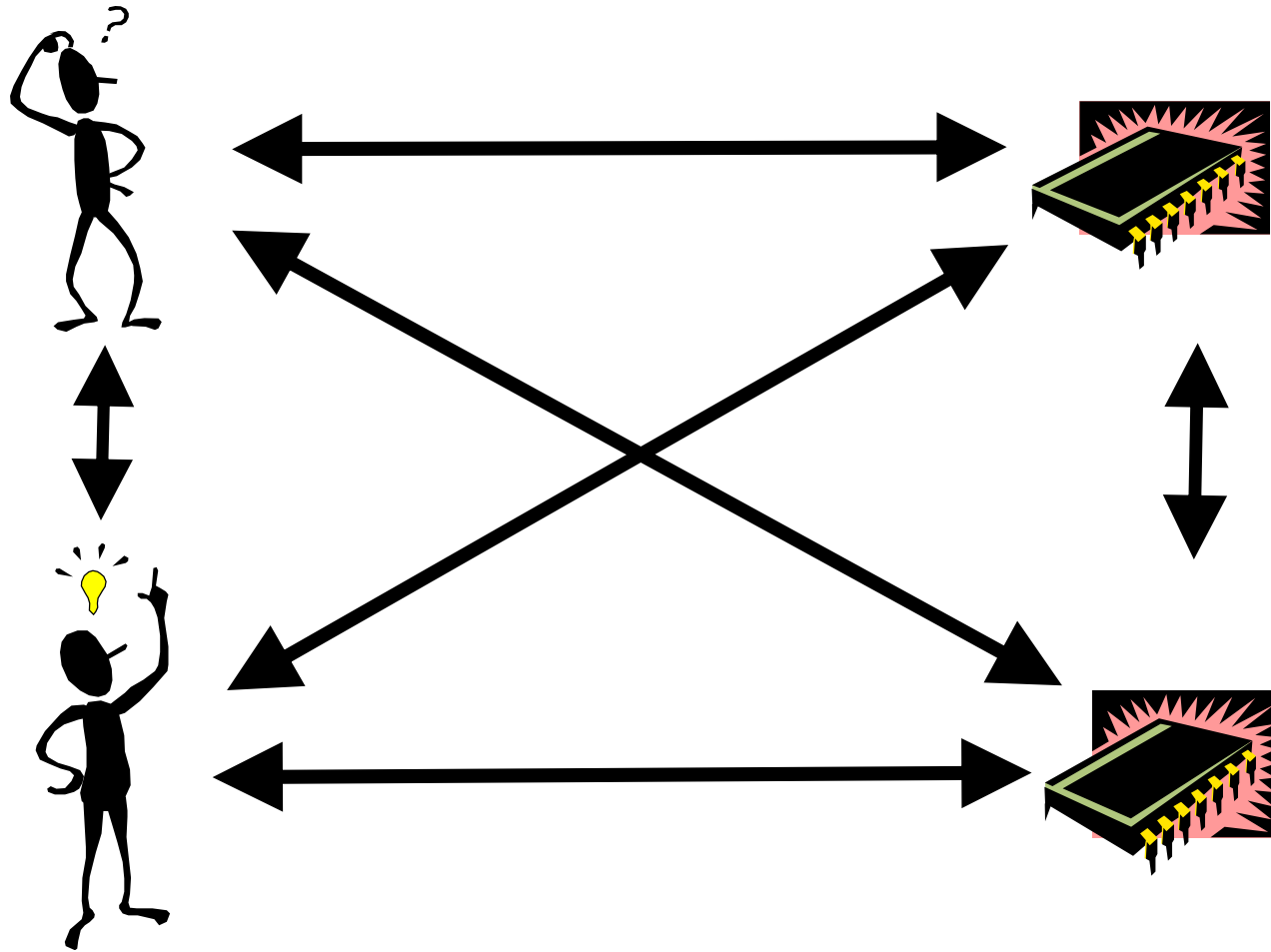
身長: 120cm 体重: 43kg



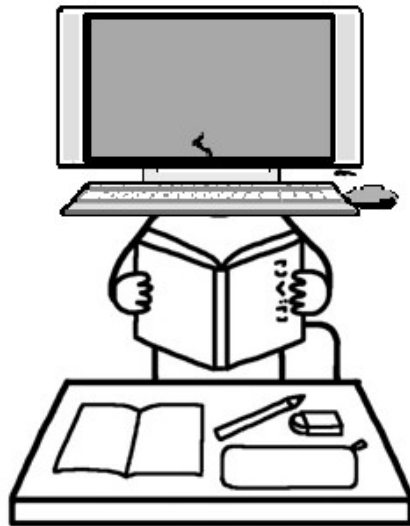
1. Stop to Give
2. Defeated by Machine
3. Collaboration



# Comprehensive Communication Sciences



# AI and NI



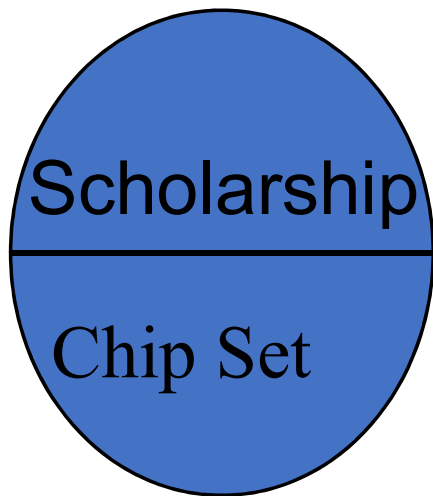
AI is FAKE without Schools and Teachers.  
Learning and Teaching are very very difficult.





# What is AI

Estimation, Approximation, Learning, Optimization, Control



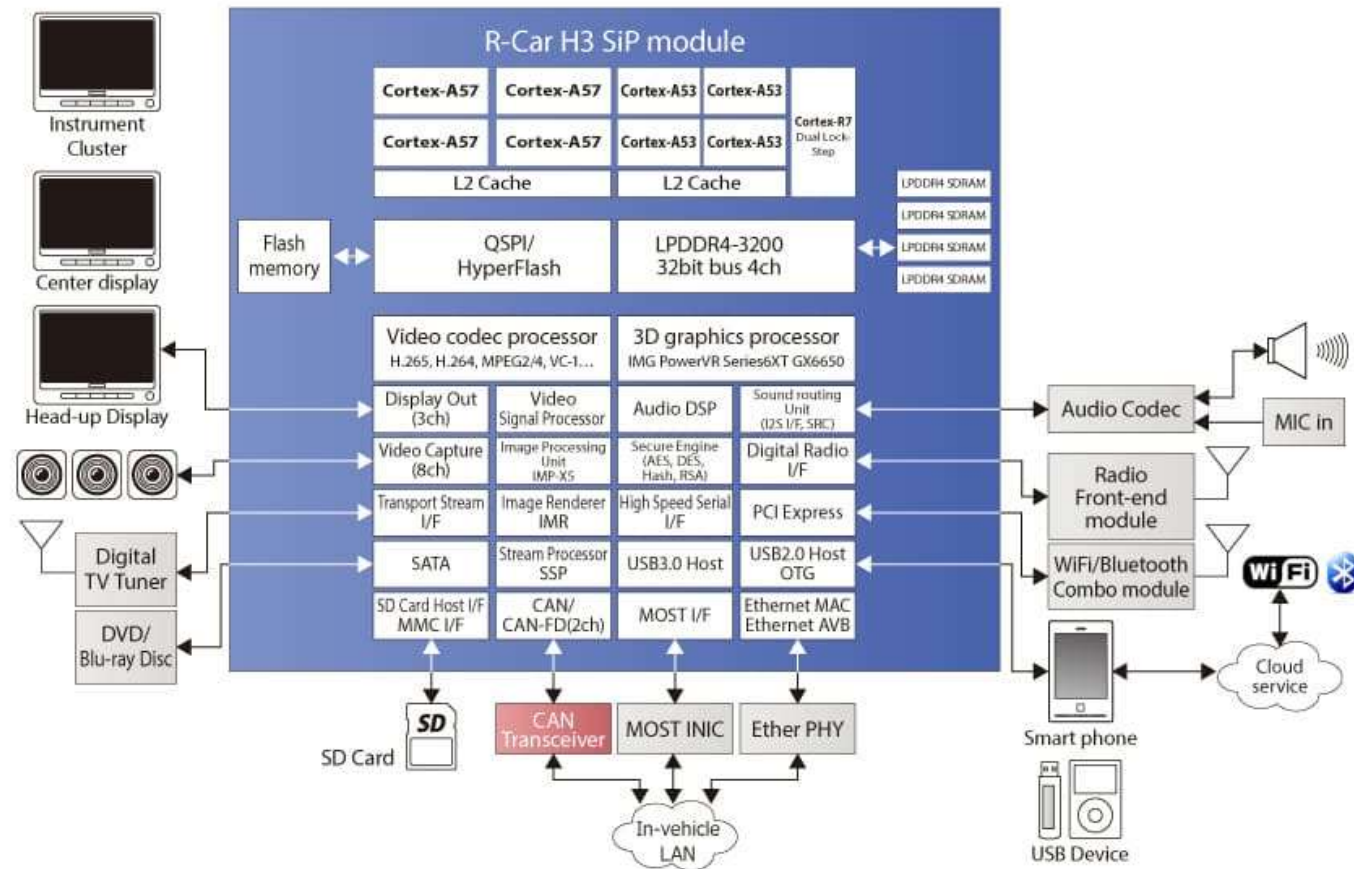
Physics, Chemical, Biology, Mathematics, Informatics,  
Sociology, Pedagogy, Literature, Medicine, Law

C++, Physon, MBD, SysML, Embedded,  
Functional Safety, Networking, Computer Graphics

Graphic Processing, Matrix Operation, Parallel Processing



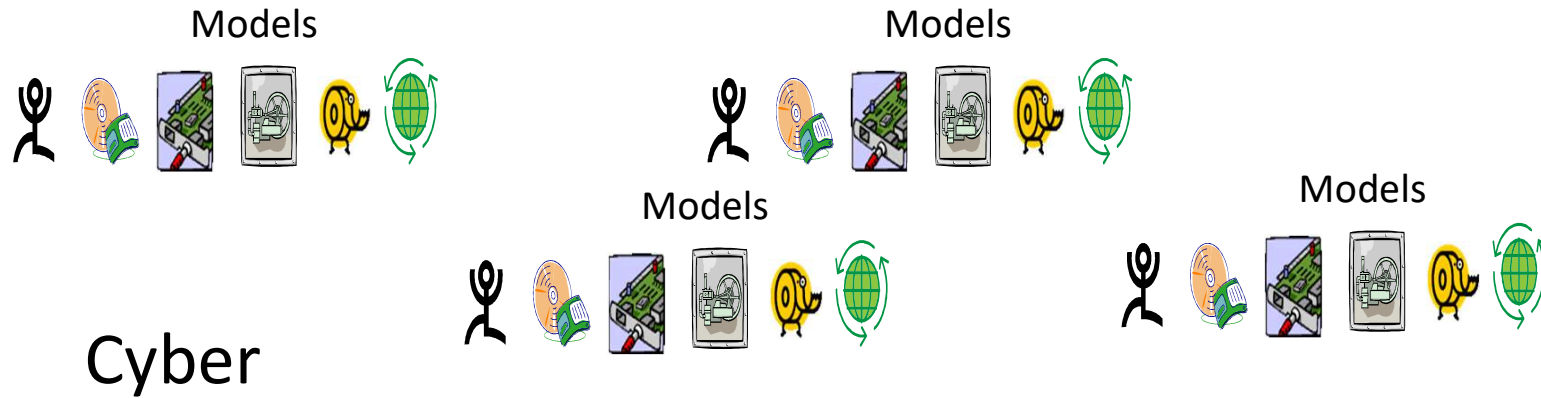
# R-Car H3



<https://www.renesas.com/jp/ja/solutions/automotive/soc/r-car-h3.html>



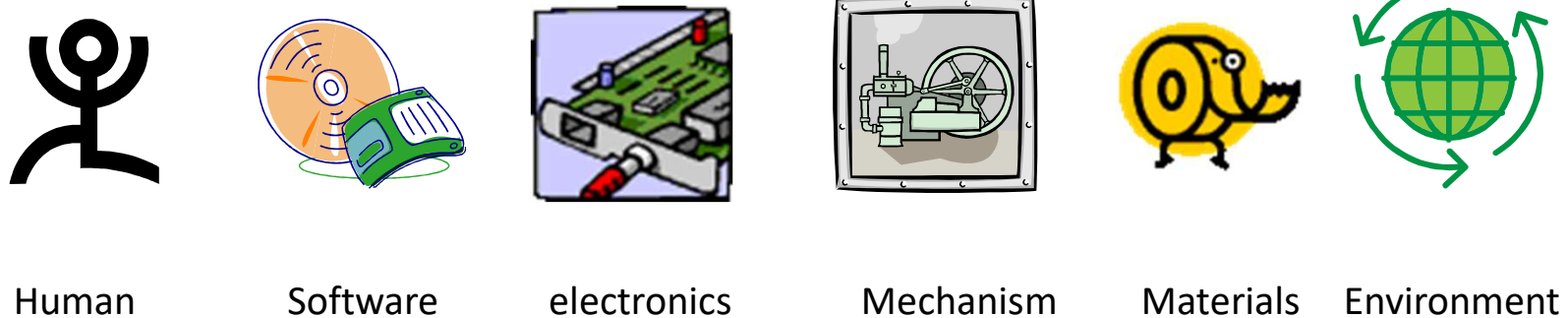
# Cyber Physical System



Many Simulations with Faults and Abnormality

Physical

Things



Dynamic Real World

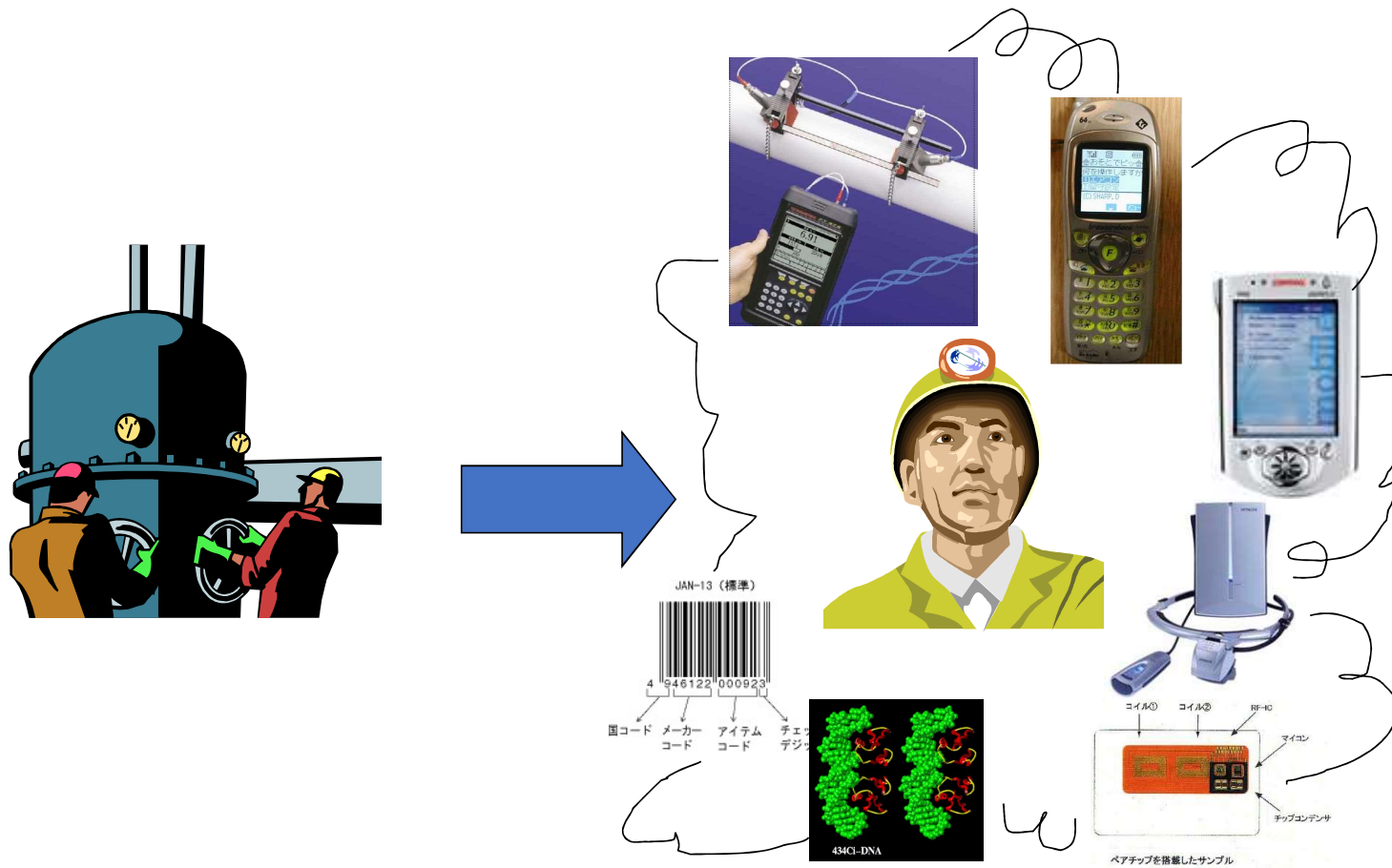


# Super Smart

- Image
- Fusion of Things and Information
- Simulation, Optimization(Real Time, Unexpected)
- 3D
- Growing Machines
- Metabolic
- Machine superior to Human.
- Direct View of End of Life



# Ubiquitous Instrumentation



# Ubiquitous

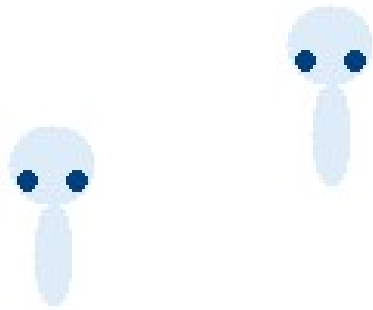
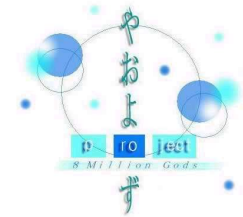
Only God Exists Everywhere.



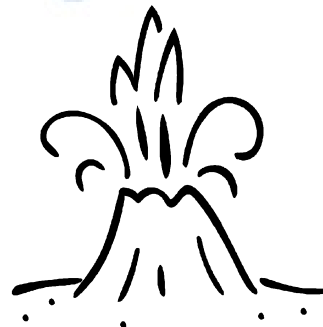
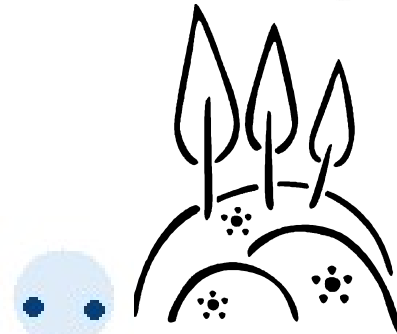
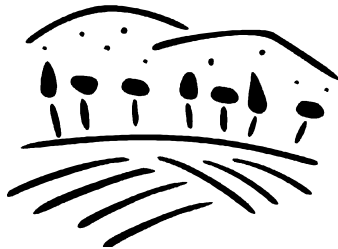
monotheism



# 8 Million Gods



Animatism

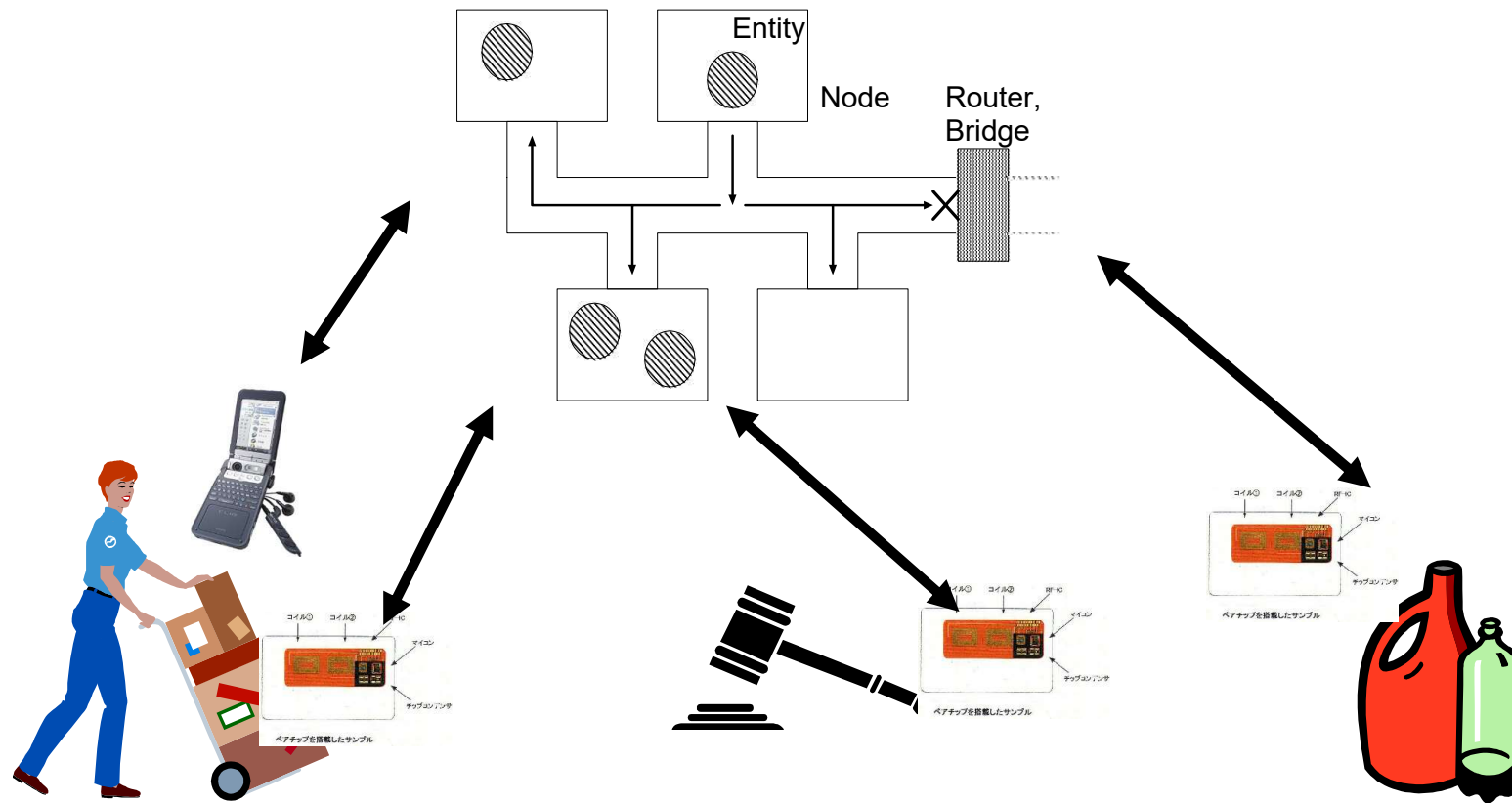


polytheism

Cheer up all things

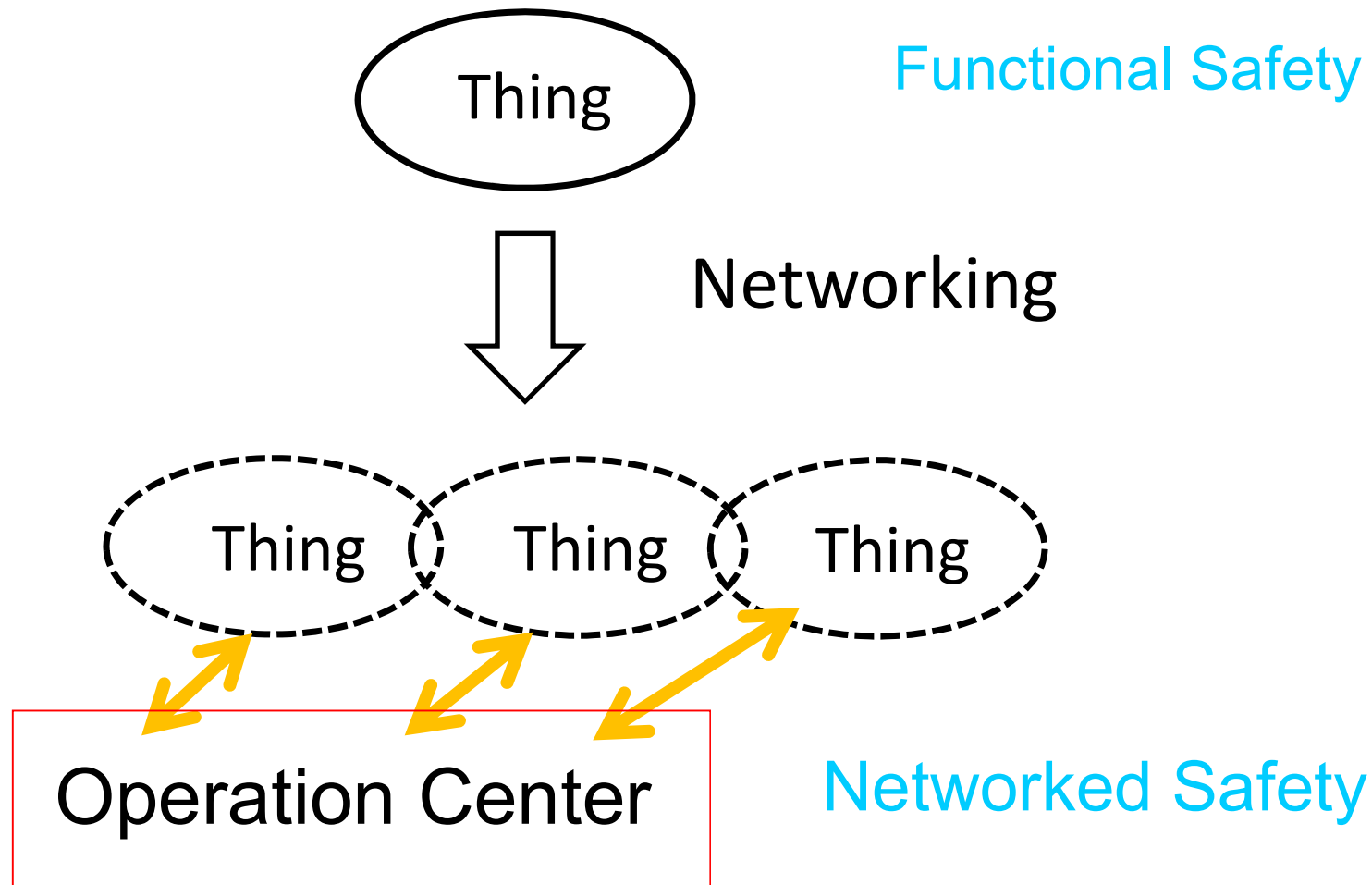


# Networking among Machines, materials, tools, and human beings

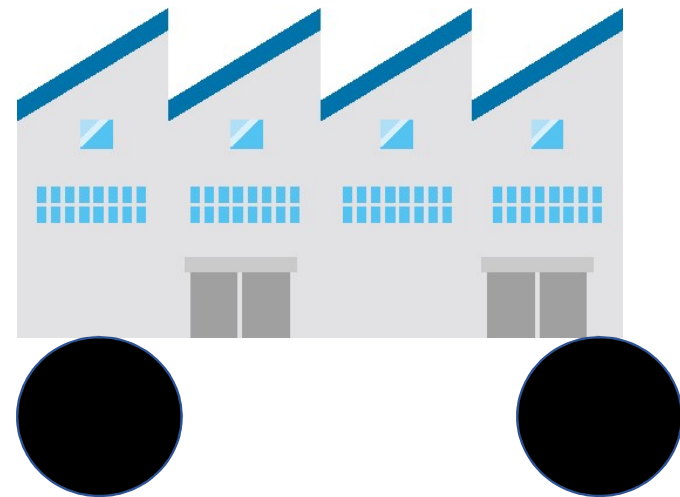
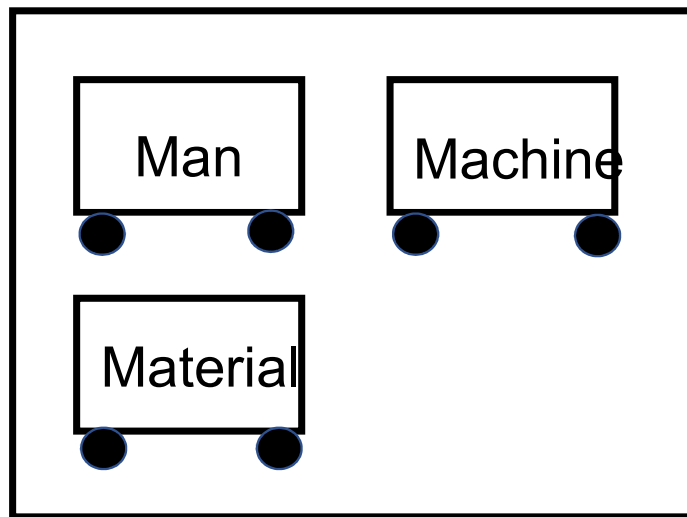




# Networking



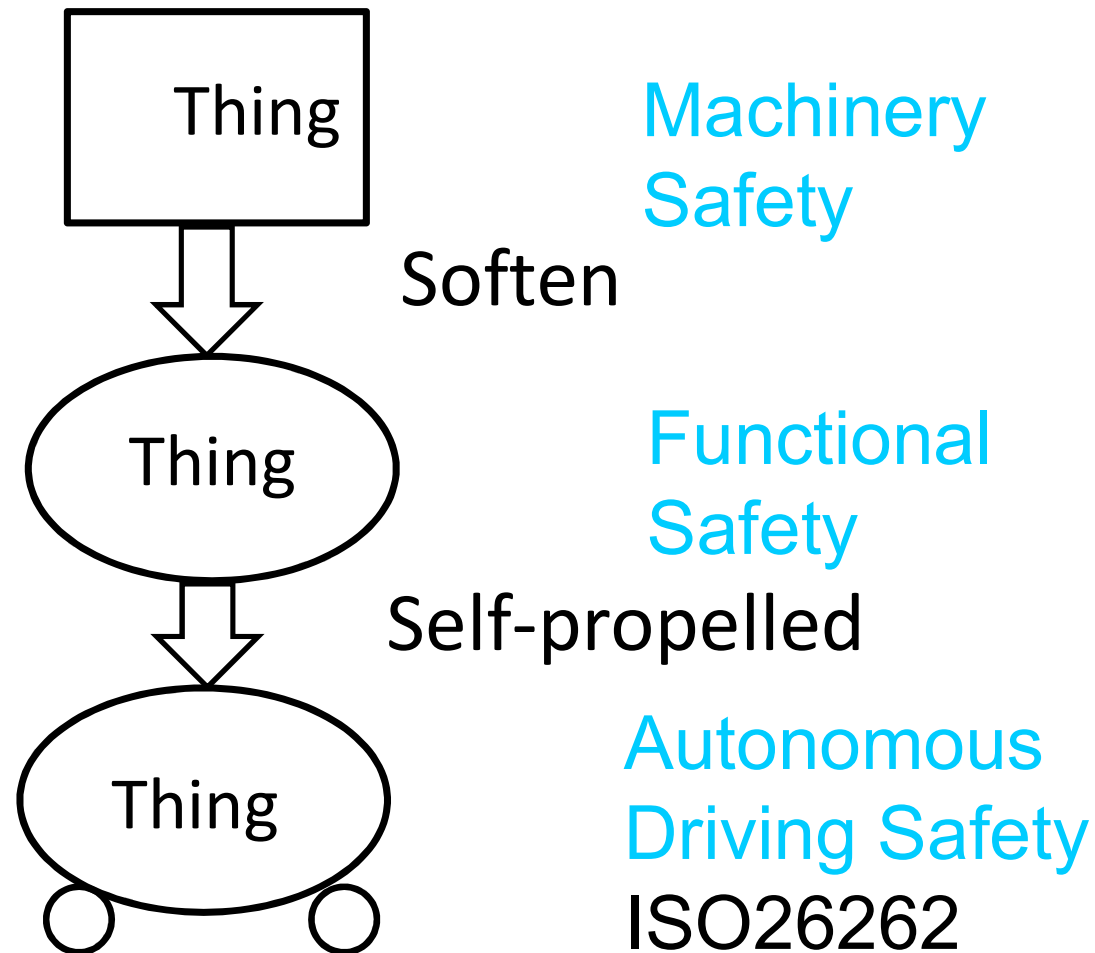
# Move machines and factory



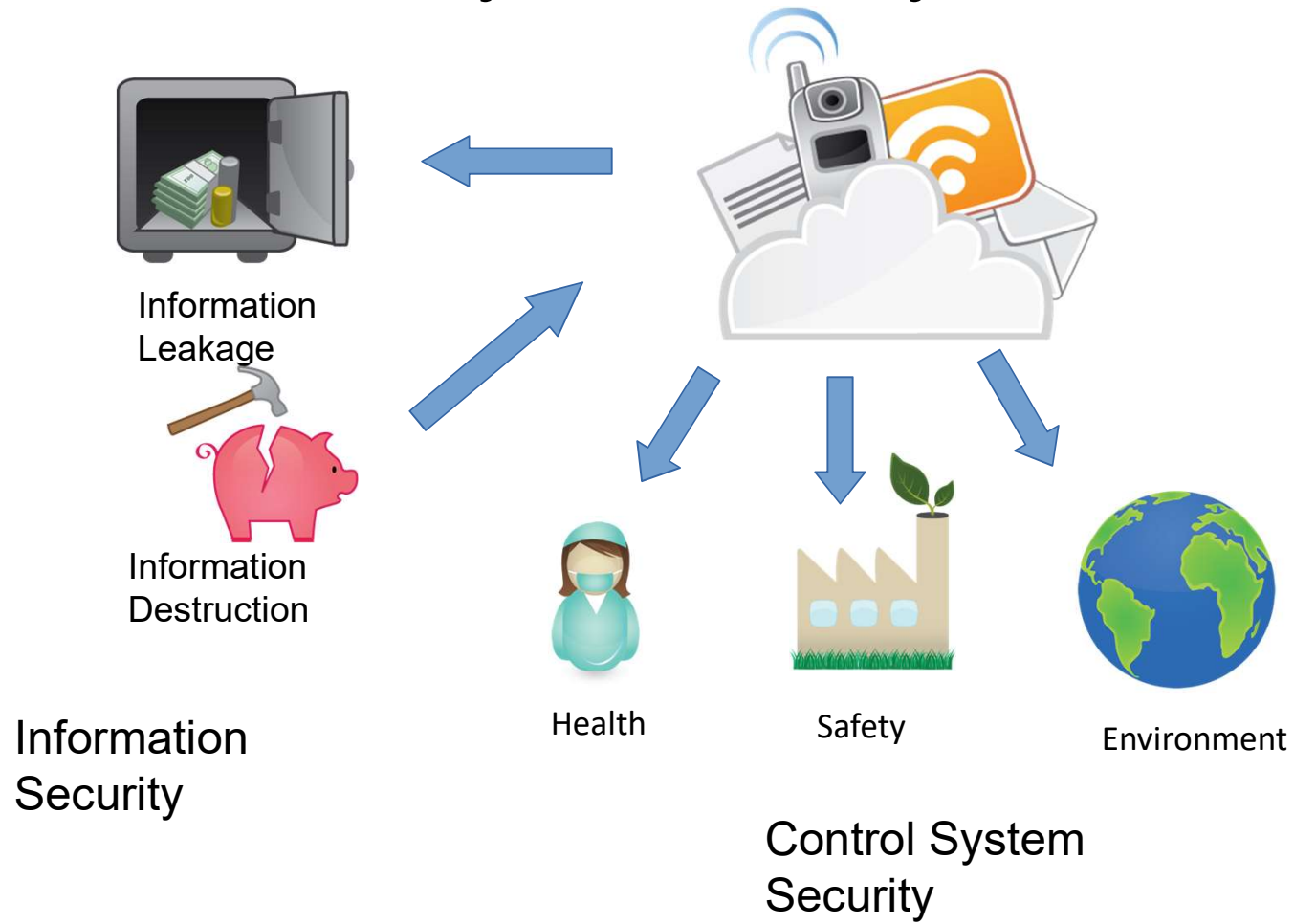
High-mix low-volume production, JIT, BCP



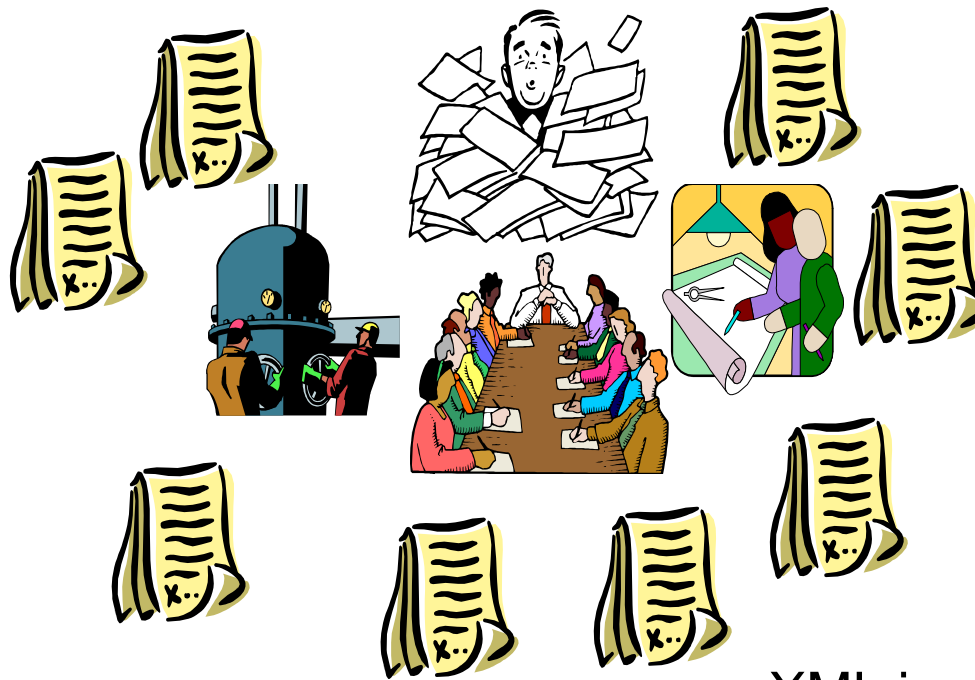
# Softening, Self-propelled



# Cyber Security



# Engineer and Documents



- planning paper
- Patent
- Design Diagram
- Assemble Manual
- Production Report
- Maintenance Manual
- Daily Report

XML is a standard of document.



# An Example of XML

```
<?xml version="1.0"?>
<!DOCTYPE Report SYSTEM "weekly.dtd">
<!--A Sample of Weekly Report-->
<report>
  <Year Month Week>
    <Year>1997</Year>
    <Month>1</Month>
    <Week>1</Week>
  </ Year Month Week >
  <Name>
    <Last>Yamada</Last>
    <First>Taro</First>
  </Name>
```

- Self Definable Markup(DTD, XML Schema)
- Markup Encoding(Thesaurus)
- Separation of Looking and Contents (XSL)
- Data+Processing(Script)
- Data Exchange +RPC (SOAP)



# Mathematical Model of Language

Mathematical Model

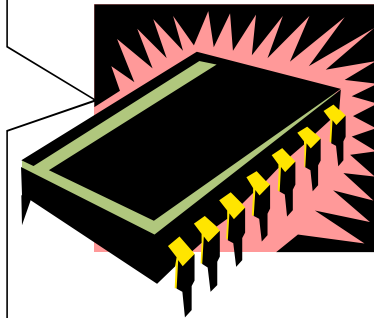
Physical Law

$$\dot{x} = Ax + Bu$$
$$y = Cx$$



- Open valve if the level over the point.
- Check temperature after 1 minutes.
- Increase flow rate when the flow is settled.

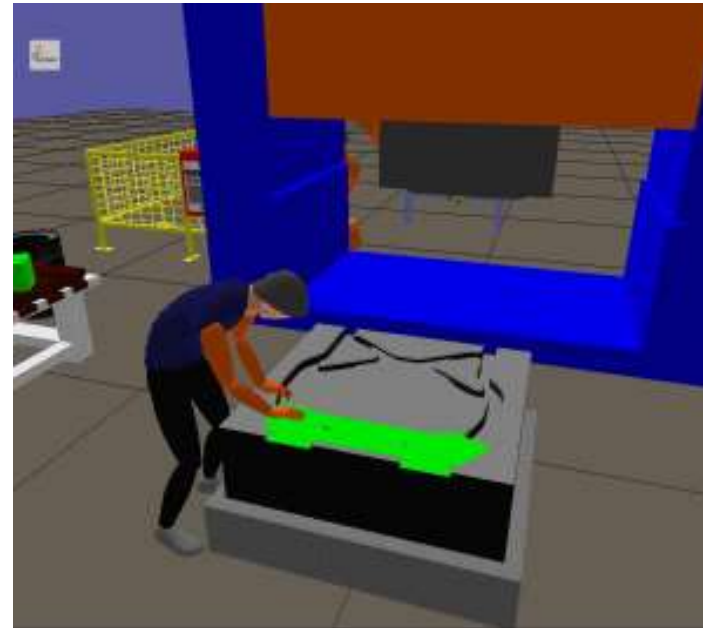
```
void bubble sort(int  
*ptr, int n) { int i, j;  
for(i=0; i<n-1;  
i++){ for(j=n-1; j>i; j--  
) { if(*(ptr+j-1) >  
*(ptr+j)) { swap((ptr+j-  
1), (ptr+j)); } } } void
```



# Delmia



<http://www.delmia.jp/>



<http://www.aikoku.co.jp/ms/catia/software/delmia/top.html>

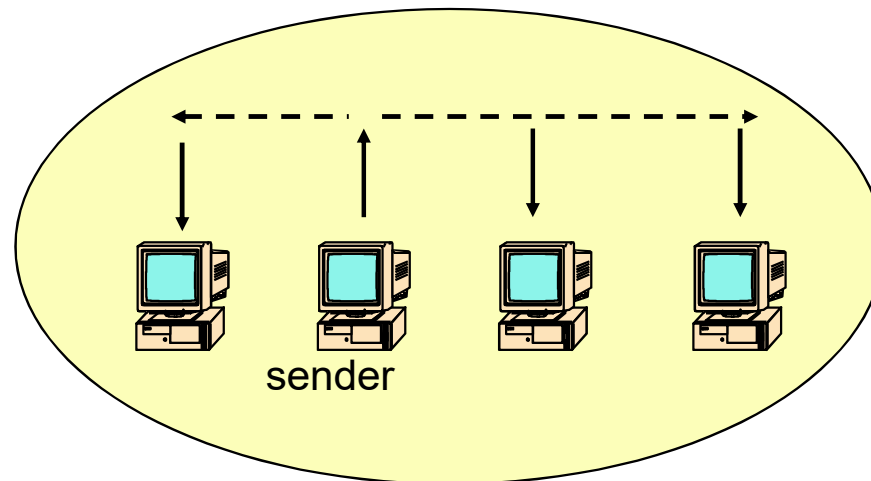
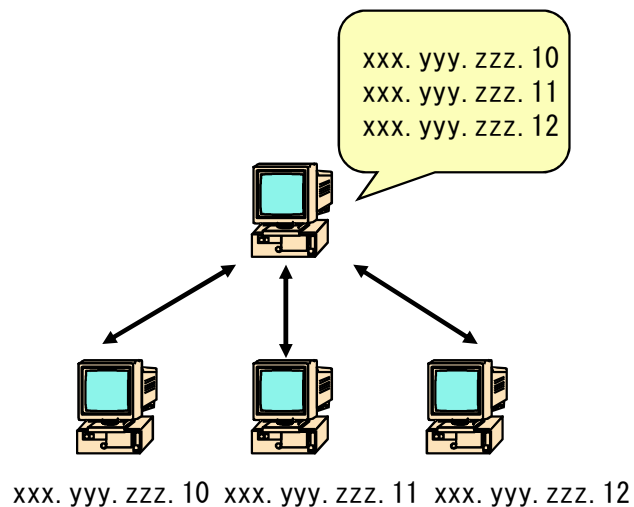




# Difference between Communication and Broadcasting

**Communication : A Sender Knows a Receiver.**

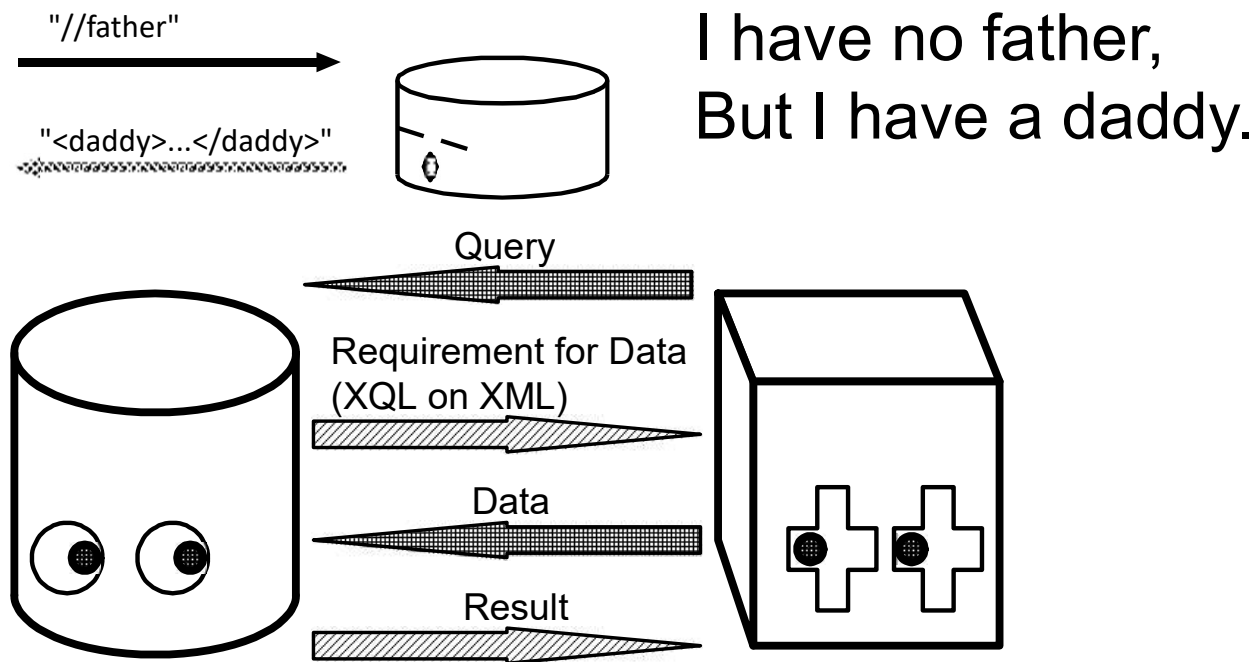
**Broadcast: A sender do not knows receivers.**



ISO15745 Part 4 ADS-net, FL-net

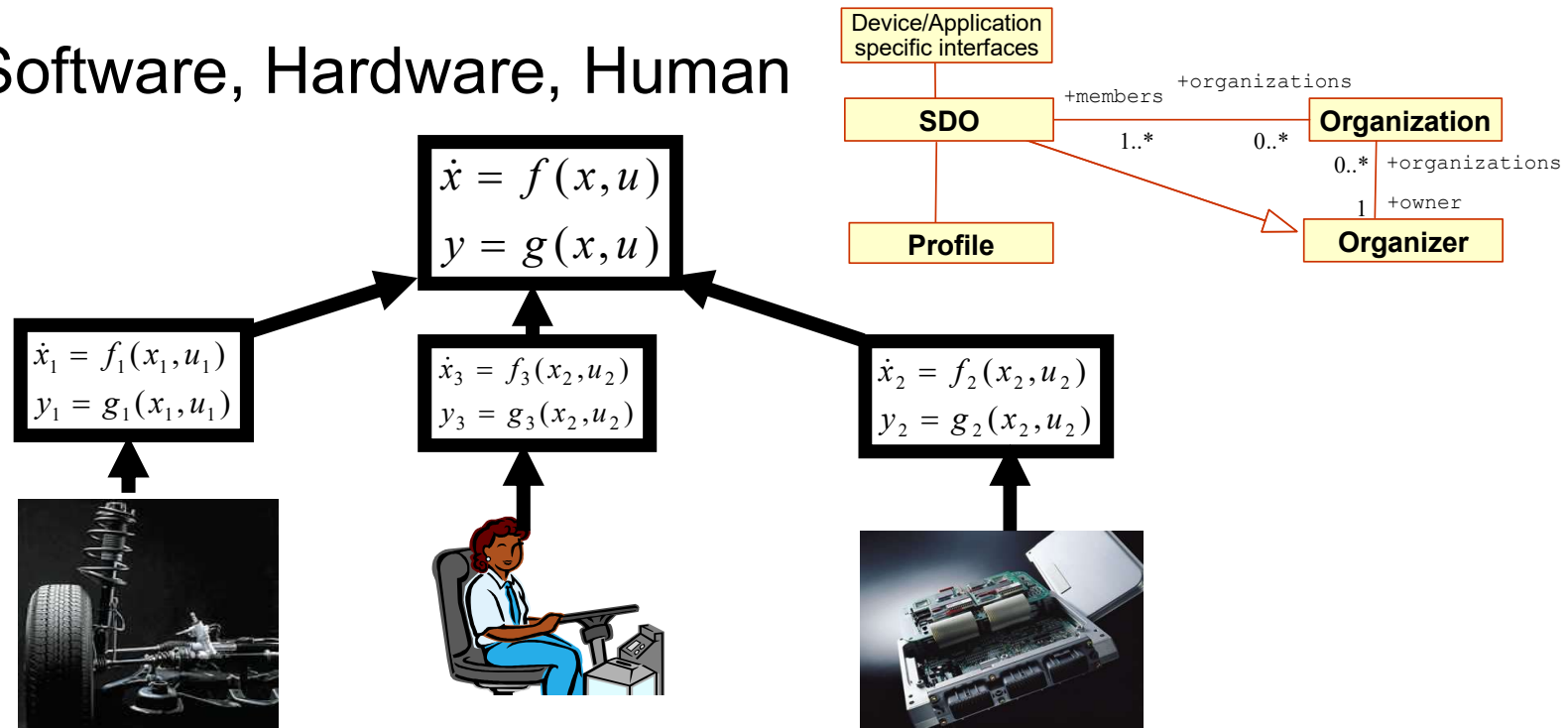


# Distributed System Driven by Inquire, not order



# SDO

Software, Hardware, Human

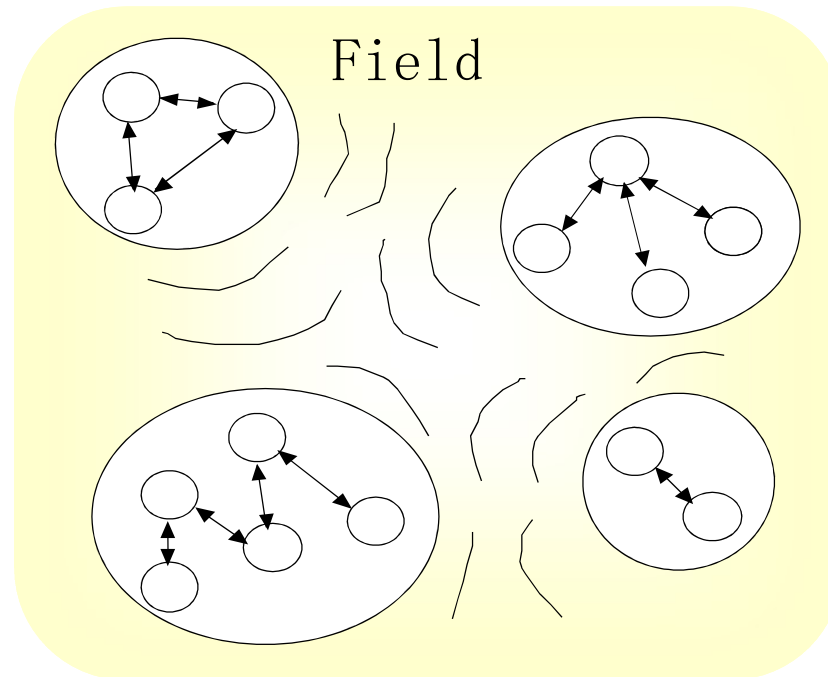


OMG Standard

Super Distributed Object → Robot Technology Component → Security, Safety, and Save



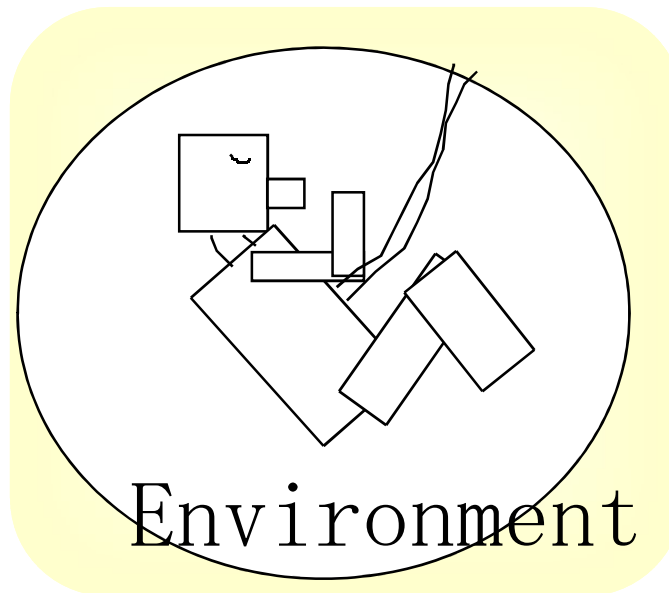
- Hormone Type Networking, not Neural one.



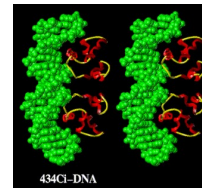
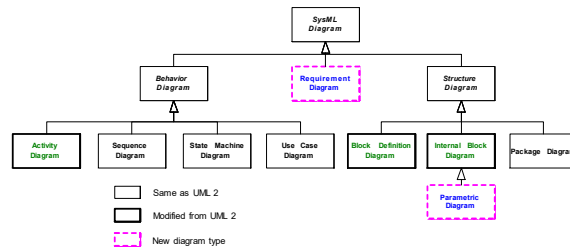
Information Exchange through Field.



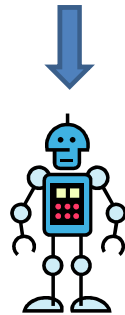
- Broadcasting Communication→Hormone System
- Neuron→Commu. To a special part
- Hormone→All Parts and Individual action



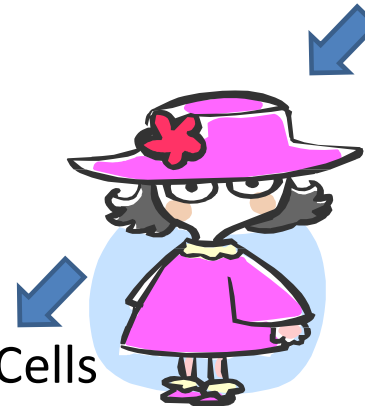
# Metabolism



5 hundred billion Cells  
to be borne.



5 hundred billion Cells  
to die.



Immune System, Hormone System

ISO Standard

ISO15745 Part 4 ADS-net, FL-net

OMG Standard

Super Distributed Object→Robot Technology Component→Security, Safety, and Save

6 thousand billion cells  
has ta same gene.



# Conclusion

- Usability, Safety, Security
- Development, Maintenance, Enlightenment
- Transfer Authority without Awareness
- Embedding Machine in a Body
- Manipulation of Human Gene

