



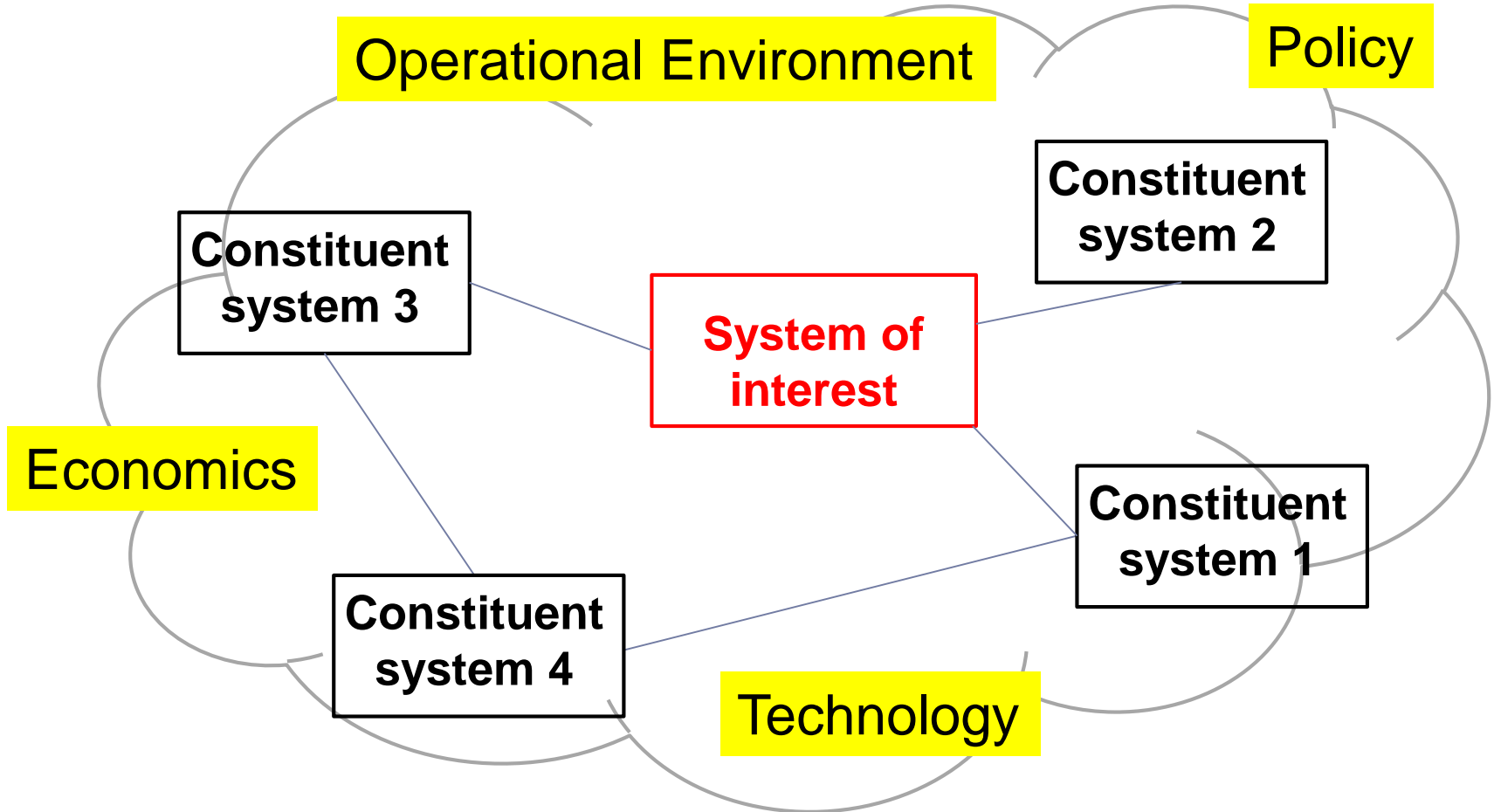
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What is the future of engineering  
for a connected world?

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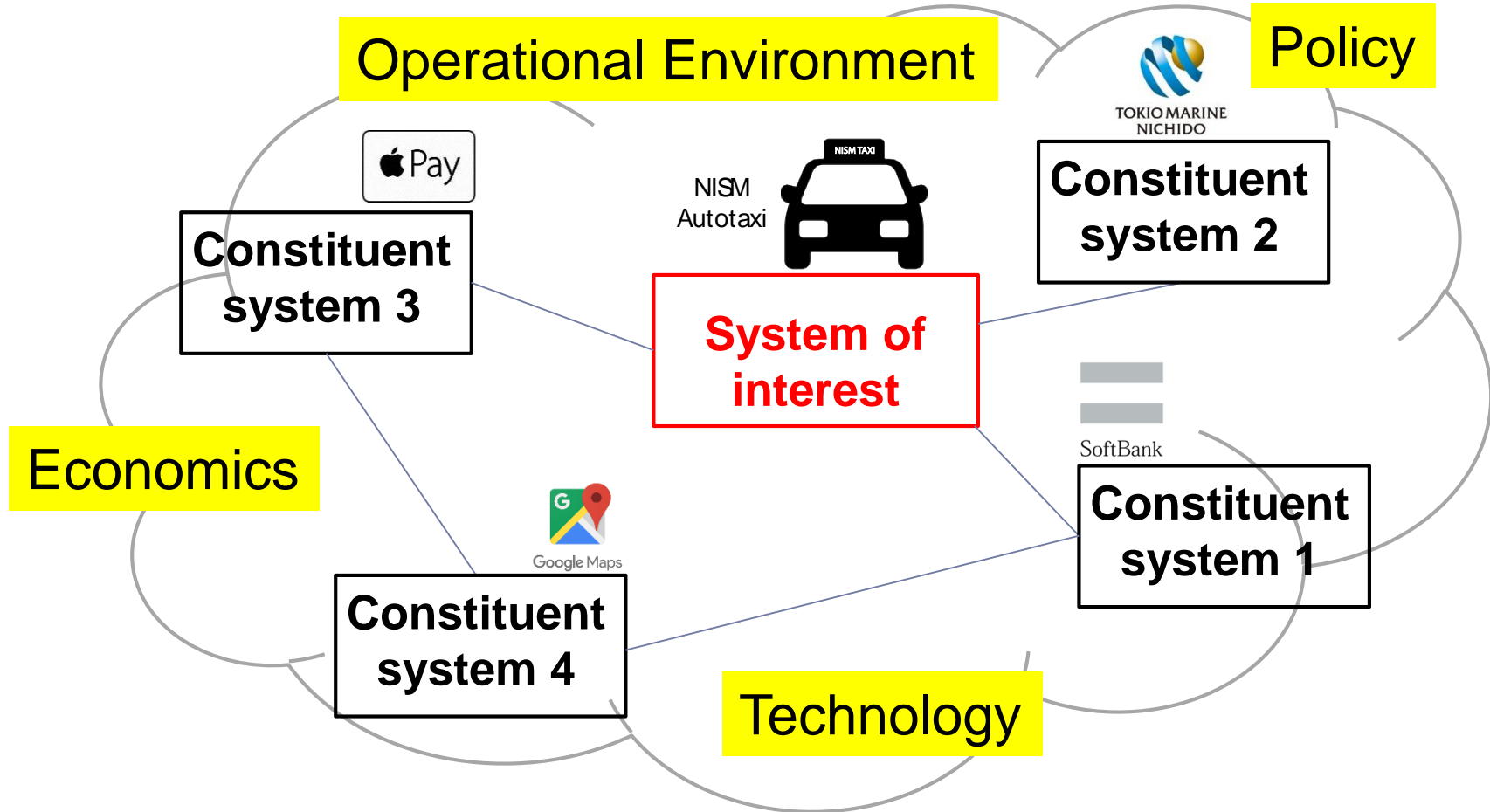
# System of Systems

- It's a connected world!



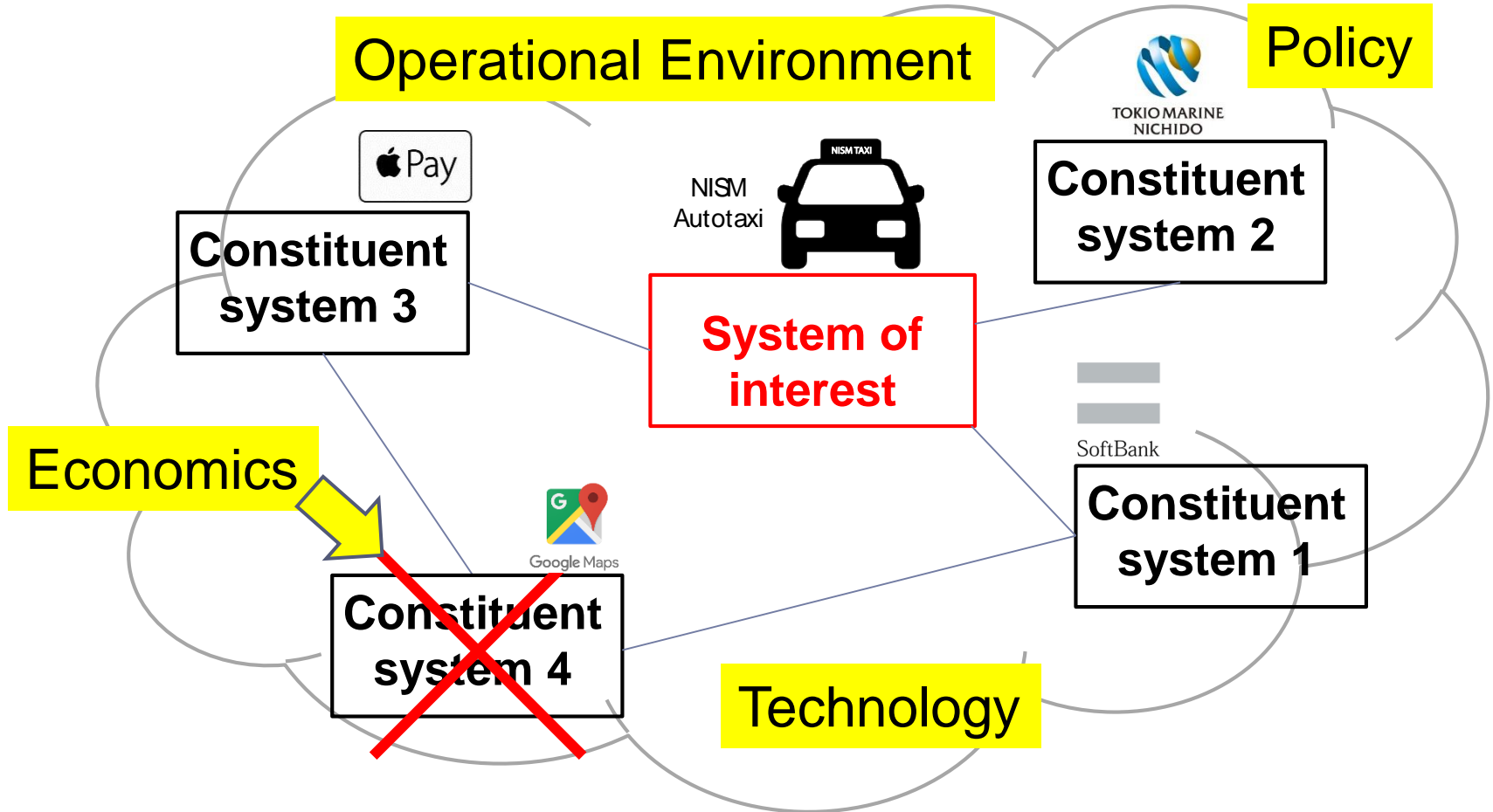
# System of Systems

- It's a connected world!



# System of Systems

- It's a connected world!



# Definition of SoS: Characterizations

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- ▶ Operational Independence of the Individual Systems
- ▶ Managerial Independence of the Systems
- ▶ Geographic Distribution
- ▶ Emergent Behavior
- ▶ Evolutionary and Adaptive Developing
  - ▶ Maier, Mark W. Architecting principles for systems-of-systems. Systems Engineering. 1998, 1.4, p. 267-284.

Acceptability Reliability  
Interoperability  
Safety  
Adaptability Connectivity  
Dependability  
Maintainability Availability  
Sustainability

Vision

Social Consensus

Social Agreement

Abstract Contract

Culture

Ethics

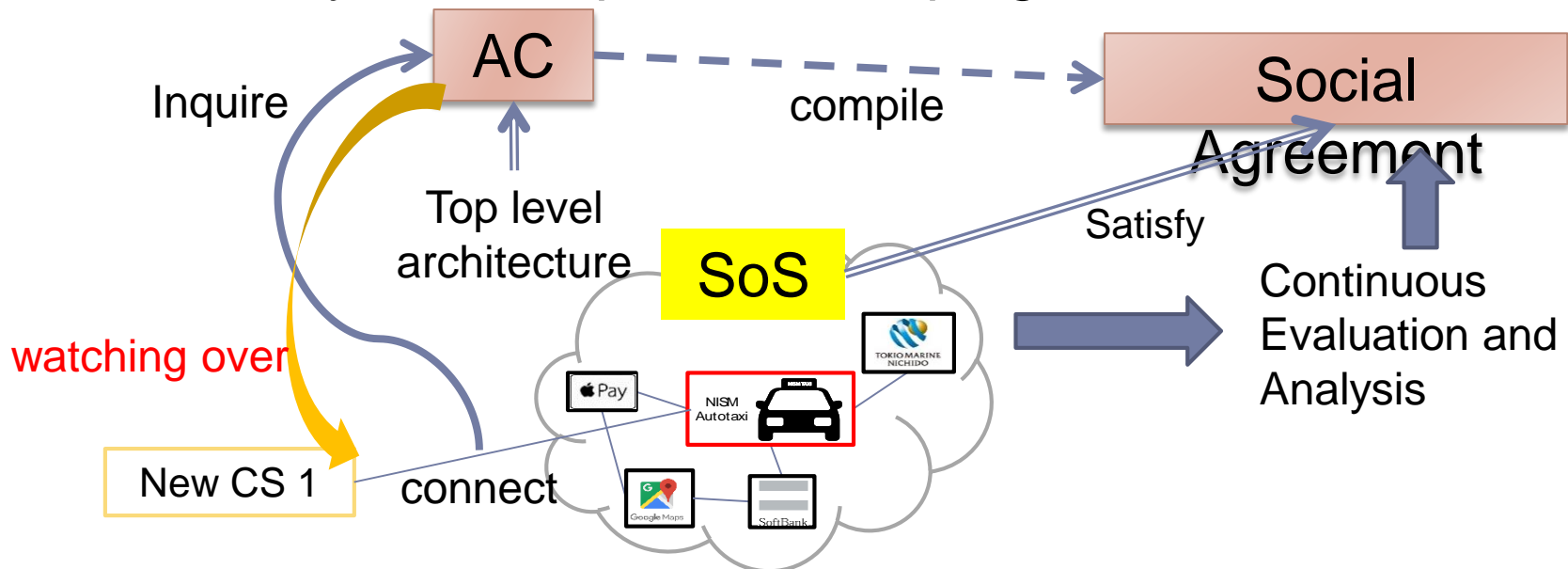
Local vs Global

Race

Religion

# The purpose of Abstract Contract?

## Evolutionary and Adaptive Developing



- ▶ Social consensus and agreement based on needs from our society, measuring human behavior
- ▶ Abstract Contract **watches over** the systems' cooperation
- ▶ Understand the identity of new CS
- ▶ Consistency to assure safety



# JST initiates our smart society

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- ▶ Keio SDM will provide practical education for students utilizing JST project to shape the next generation of a smart society (超スマート社会).
- ▶ JST (Japan Science and Technology Agency) provides funds for research projects.



# Issue of engineering for SoS

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- ▶ How shall we apply systems engineering approach to SoS?
  - ▶ It can be useful or effective?
- ▶ How shall we model SoS and perform simulation?
- ▶ How shall we treat with interface among constituent systems?
- ▶ How shall we define the boundary of SoS?
- ▶ How shall we address emergent behavior of SoS?
- ▶ How shall we address **management of SoS** to be evolved temporally?
- ▶ How shall we **accommodate social agreement or consensus** in SoS engineering?

# Requirements for future engineers

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Baseline = Systems engineering

Especially

- ▶ Understanding **behavior** or **dynamics** of systems
- ▶ **Modeling skills** (**Descriptive models** as well as simulation models)
- ▶ Adaptive and collaborative to enhance **communication**

Further training to understand ...

- ▶ **“Autonomous”** = Self-governing
- ▶ **“Symbiosis”**
- ▶ **“Intelligence”** can connect “Self-governing” with “Symbiosis”.

# Philosophy of Keio University

## Independence and Self-Respect

独立自尊

*Dokuritsu Jison*

Independence and Self-Respect

“Whosoever perfectly realizes the principle of Independence, both of Mind and Body, and, paying due respect to his own person, preserves his dignity unblemished—him we call a man of independence and self-respect.”

The basic spirit of Keio University is that of independence and self-respect, to protect the dignity of oneself and others and act with discretion and responsibility in every matter.

## Learning while Teaching, Teaching while Learning

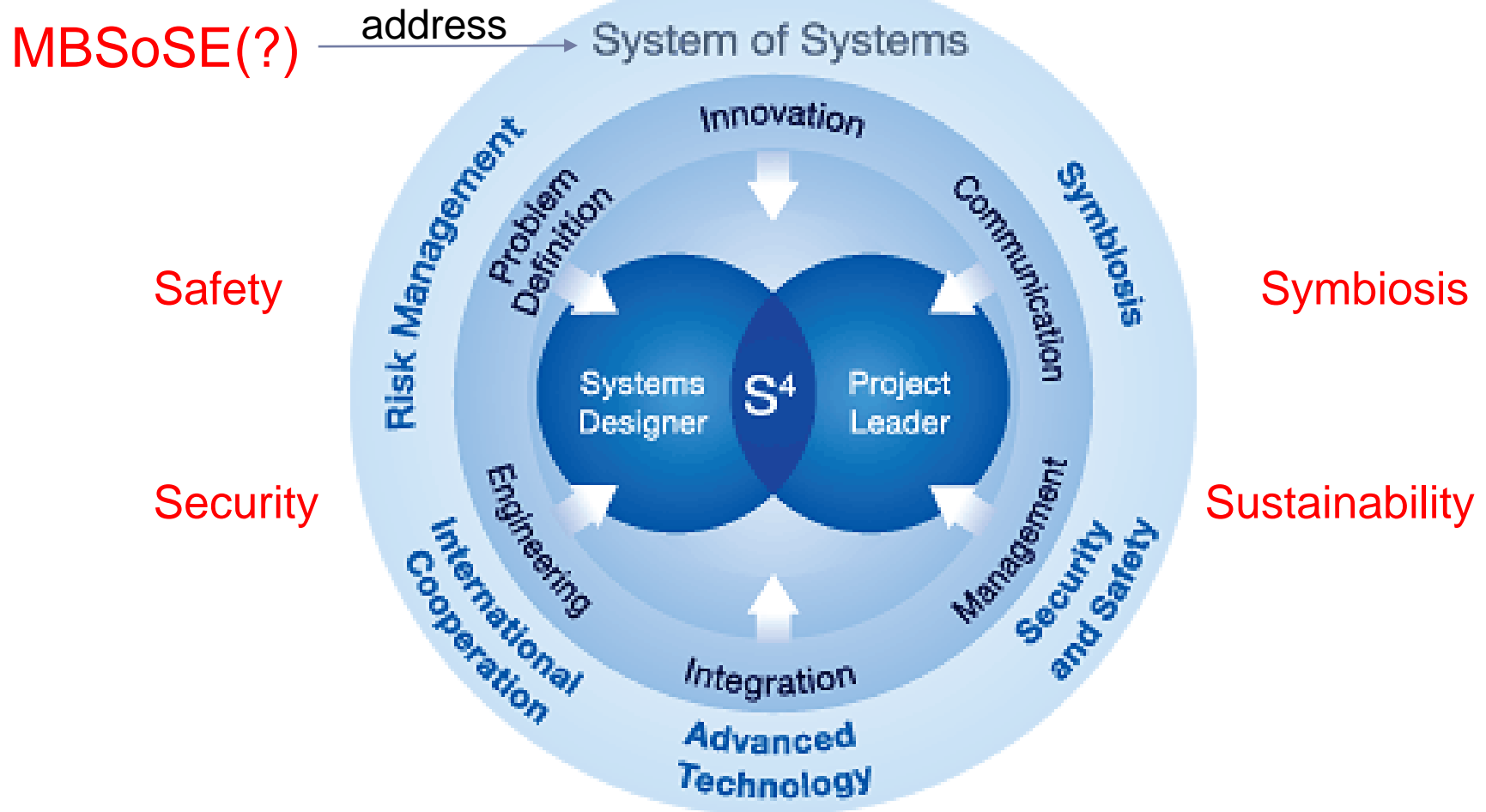
半学半教

*Hangaku-hankyo*

Learning while Teaching,  
Teaching while Learning

The principle of *hangaku-hankyo* unites Keio members and makes no distinction between pupil and teacher, between the learned and those just beginning to learn. From Keio’s humble beginnings, there has been a spirit that students and teachers alike have the capacity to both teach and learn together.

# Keio System Design and Management



MBSE Visiting Lecturers: Sandy Friedenthal, Rick Steiner, Russel Peak, Laurent Balmelli