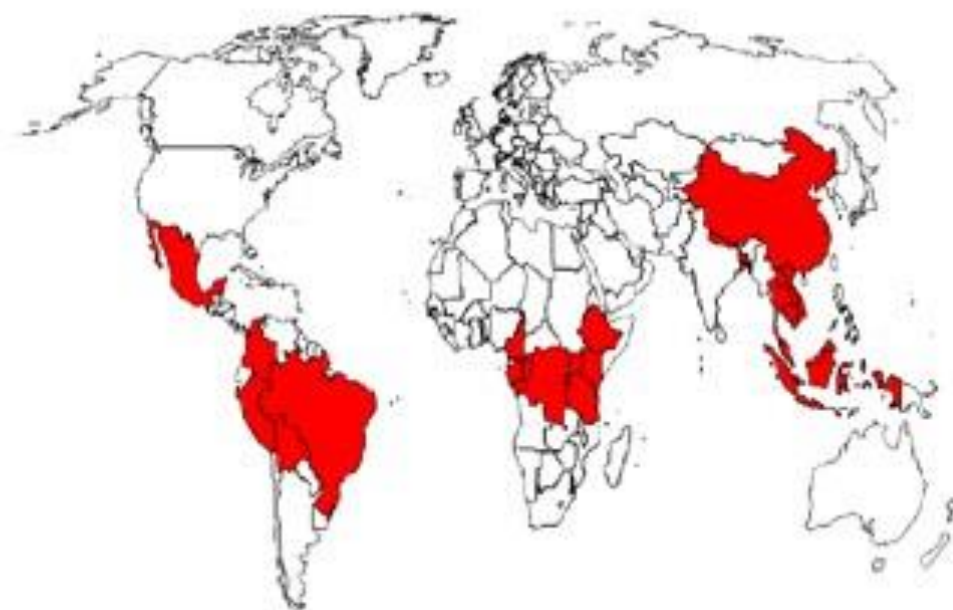


Determinants of collaboration of government organizations: based on Agent-based Modeling Simulation





Focus countries for USAID's *Emerging Pandemic Threats* program.

Experiment

Prediction

Simulation Method

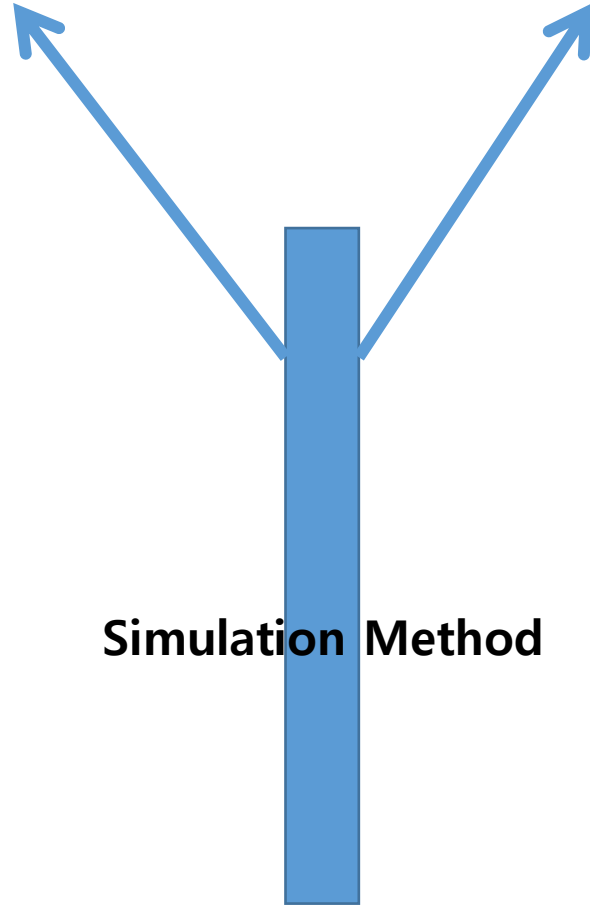


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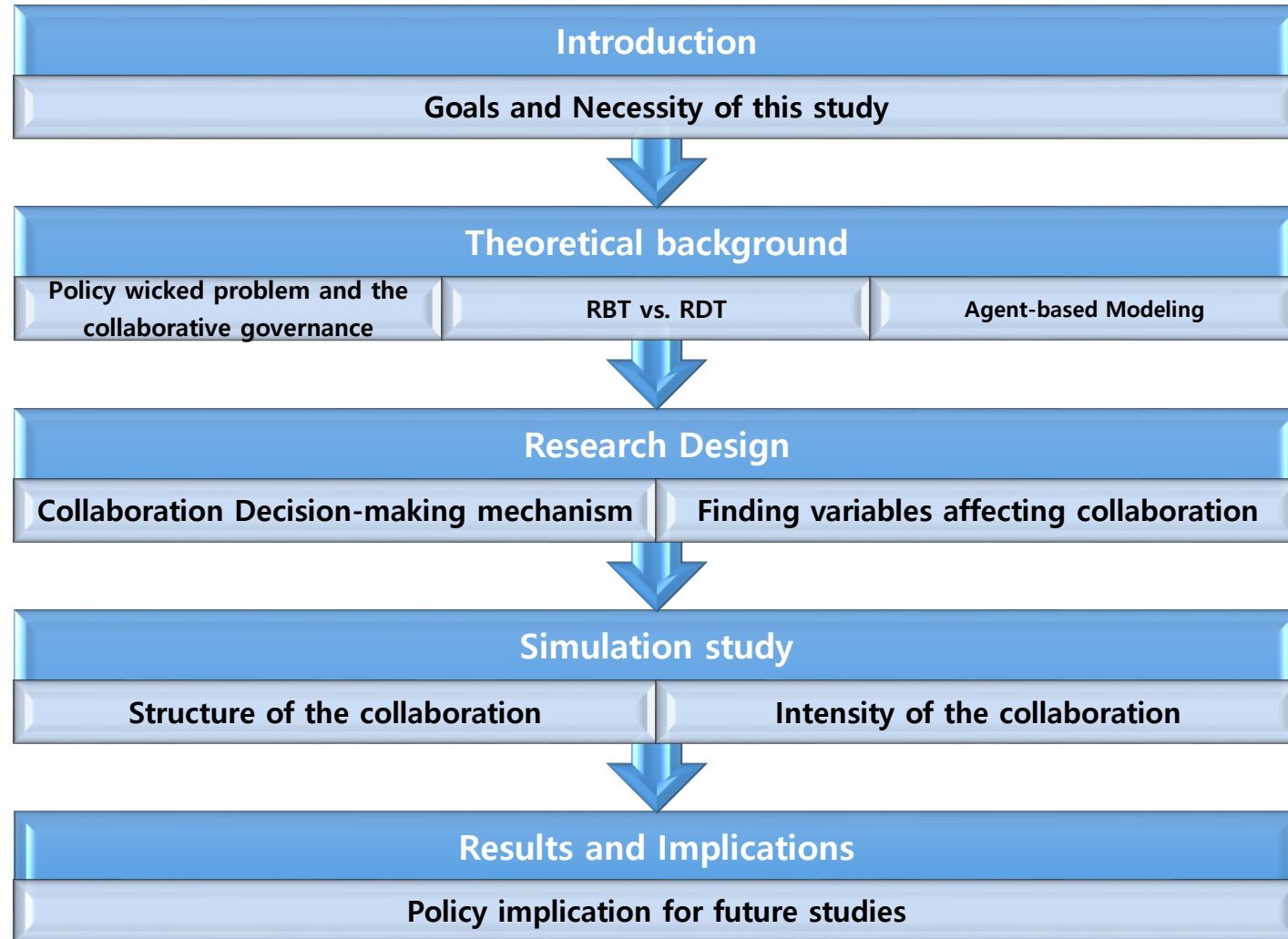
1. Introduction
2. Theoretical Background
3. Research Design
4. Agent-based model simulation
5. Plans for the 2nd year study



• Main goals of the presentation

- Checking the potential of the Agent-based Modeling Simulation in public policy analysis
- Resource Dependency Theory vs. Resource Based Theory
- Comments for the 2nd year study

• Structure of the 1st year study



Chapter 2

Theoretical Background



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01 Policy Wicked Problem and Collaboration

- we are now facing a variety of policy challenges as we experience COVID-19
- **“compelling global wicked problem”**
- High level of volatility, uncertainty, complexity, ambiguity



01

Policy Wicked Problem and Collaboration

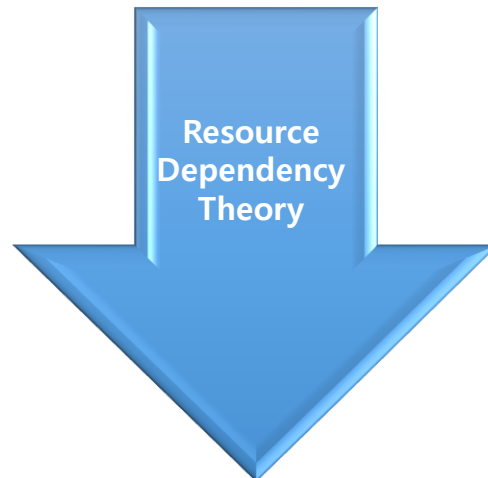
PEST	Category	Description
Political	politics	Reconsidering democracy
		Establishment of nation-centrism and the emergence of closed cities
	National security	Weakening of international cooperation and collaboration New Cold War (US vs. China)
		4 th Industrial revolution and international competition
Economic	economics	US-China trade conflict
		Protectionism
		Global economic downturn and unemployment problem
	industry	4 th Industrial revolution and industry structure reorganization
		Growth of ICT-based new industries

PEST	Category	Description
Social	Social welfare	Strengthening social safety nets and increasing the need for support for the vulnerable people
		Community-centered care
	education	Un-tact education and equity
		New technology utilization and training
	culture	Change of the culture industry environment
		Community-centered culture industry
Technological	Science and technology	Acceleration of new industries and new technologies
		Privacy and digital ethics
	Energy and environment	Climate Change
		Renewable energy developmenmt

02 RBT vs. RDT



- firm's internal resources and capabilities are key drivers of its competitive advantage and long-term success
- Emphasizes the importance of identifying and managing a firm's resource and capabilities
- **Internal readiness for collaboration**



- organization depends on external resource to survive and thrive
- organization is influenced by the availability, accessibility, and control of external resources
- **External support for collaboration**

03 Agent-based Modeling

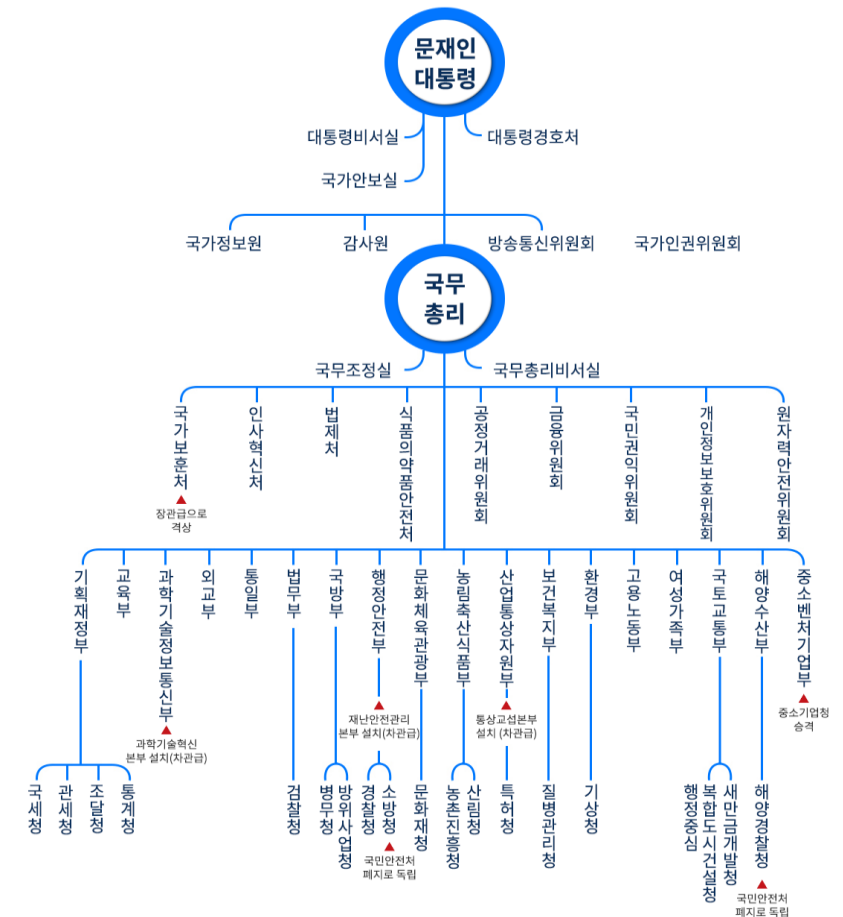
- An agent-based model is a type of computational model that simulates the behavior of individual agents and their interactions within a complex system
- The ABM model consists of multiple autonomous agents, each of which has its own set of rules and decision-making processes
- These agents interact with each other and their environment according to specified rules and parameters, allowing researchers to observe emergent properties and patterns that arise from the interactions of the agents
- Agent-based Modeling can be used in the following situations:
 - ① If the heterogeneity of the agents is important
 - ② If the interaction between the agents is complex
 - ③ If the agent's behavior shows complex patterns, such as learning

03 Agent-based Modeling

ABM components	Explanation	In my study
Composition	a collection of the parts of the system	47 ministries and agencies in Korean central government
Environment	a collection of items other than those in s, on which s can act or be acted upon	Characteristics of external environment
Structure	a collection of relations that keep the system whole	Network, Characteristics of organization and related policies
Mechanism	a collection of processes that allows to perform its specific function	Collaborative behavior decision making process (1 st stage-4 th stage)
Emergence	Output	Network strength Network structure

문재인 정부 조직 개편

18부처 5처 17청, 2원 4실 6위원회(52개) ▶ 18부 4처 18청 7위원회, 2원 4실 1처(54개)



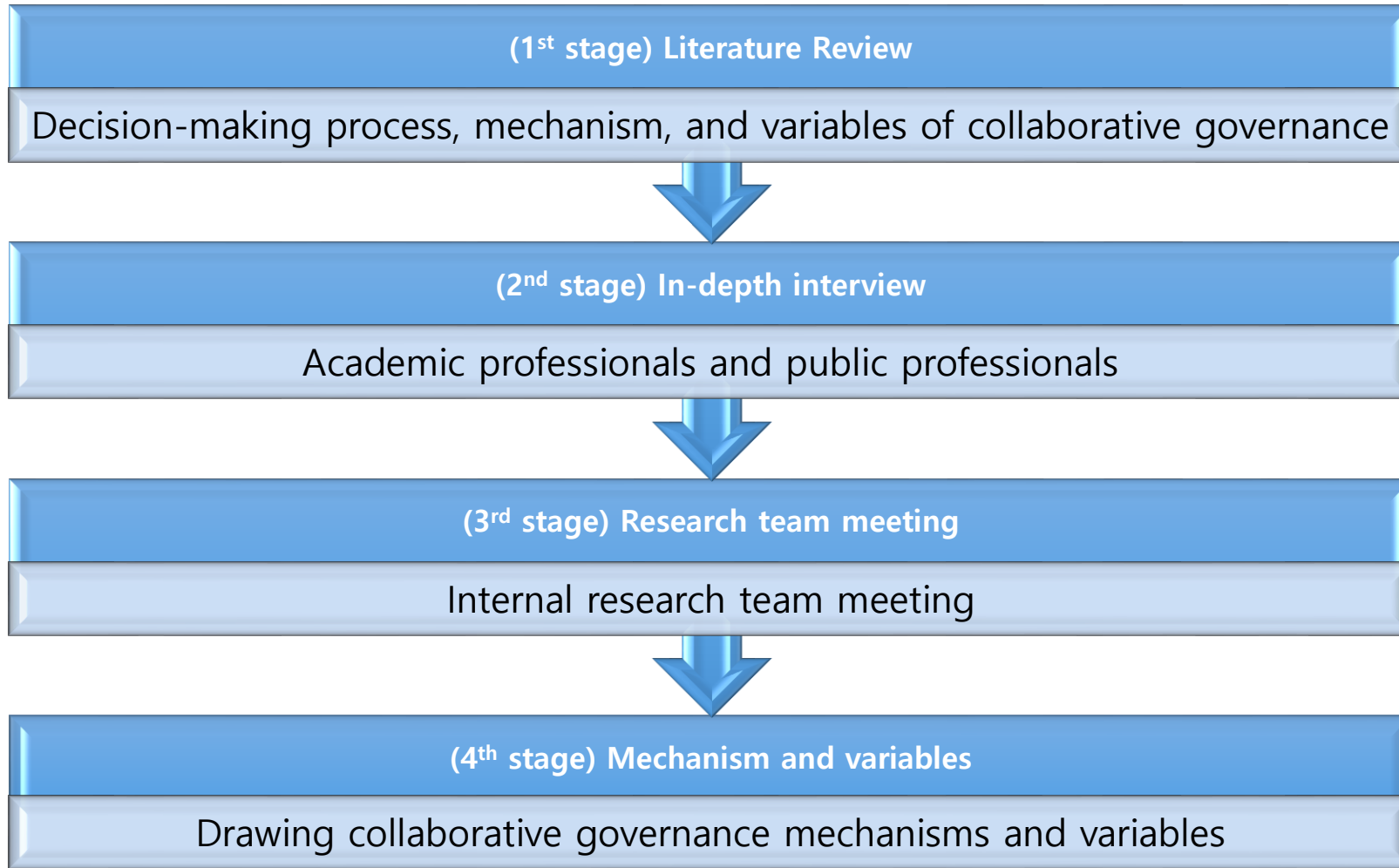
Chapter 3

ABM Research Design

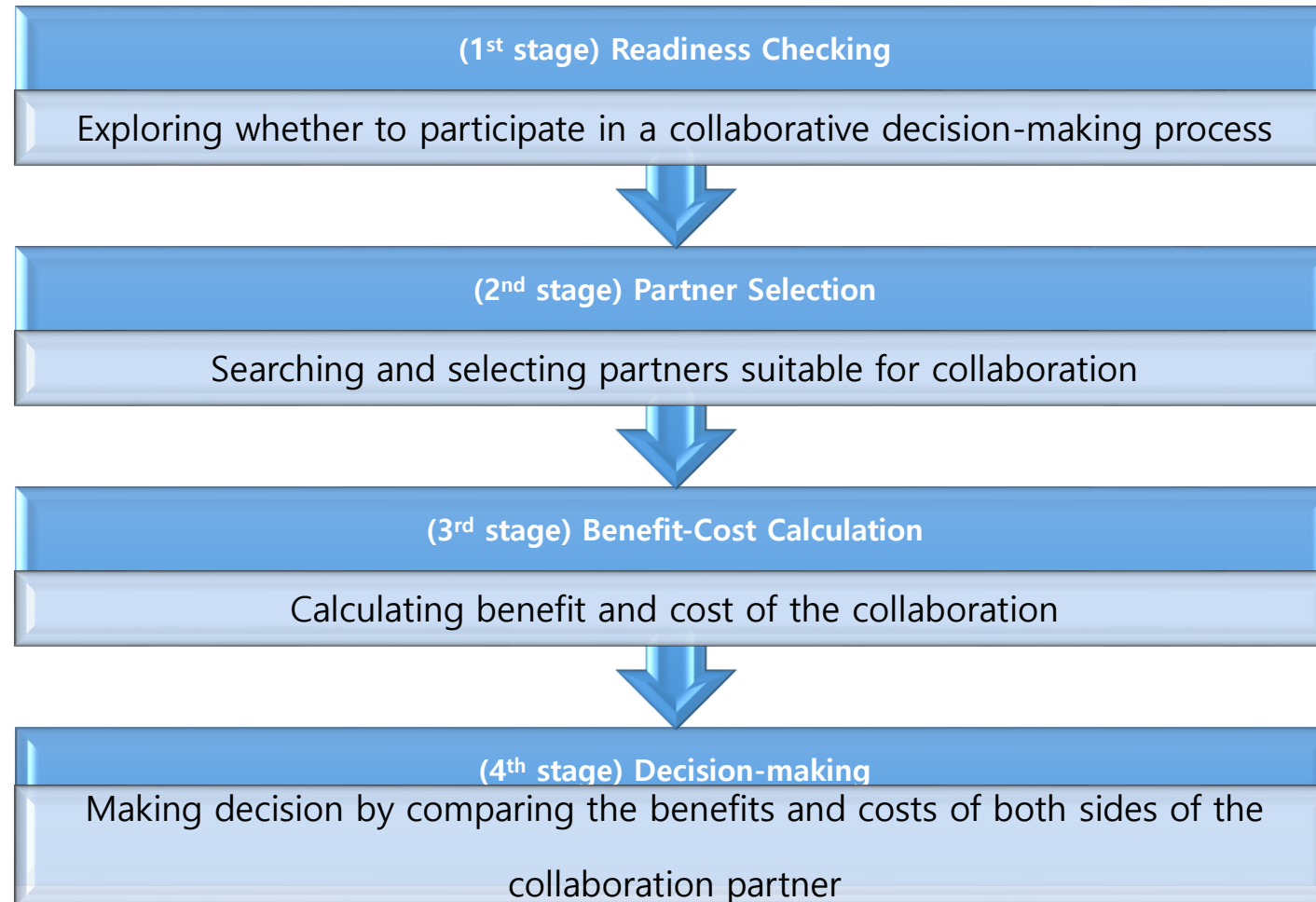


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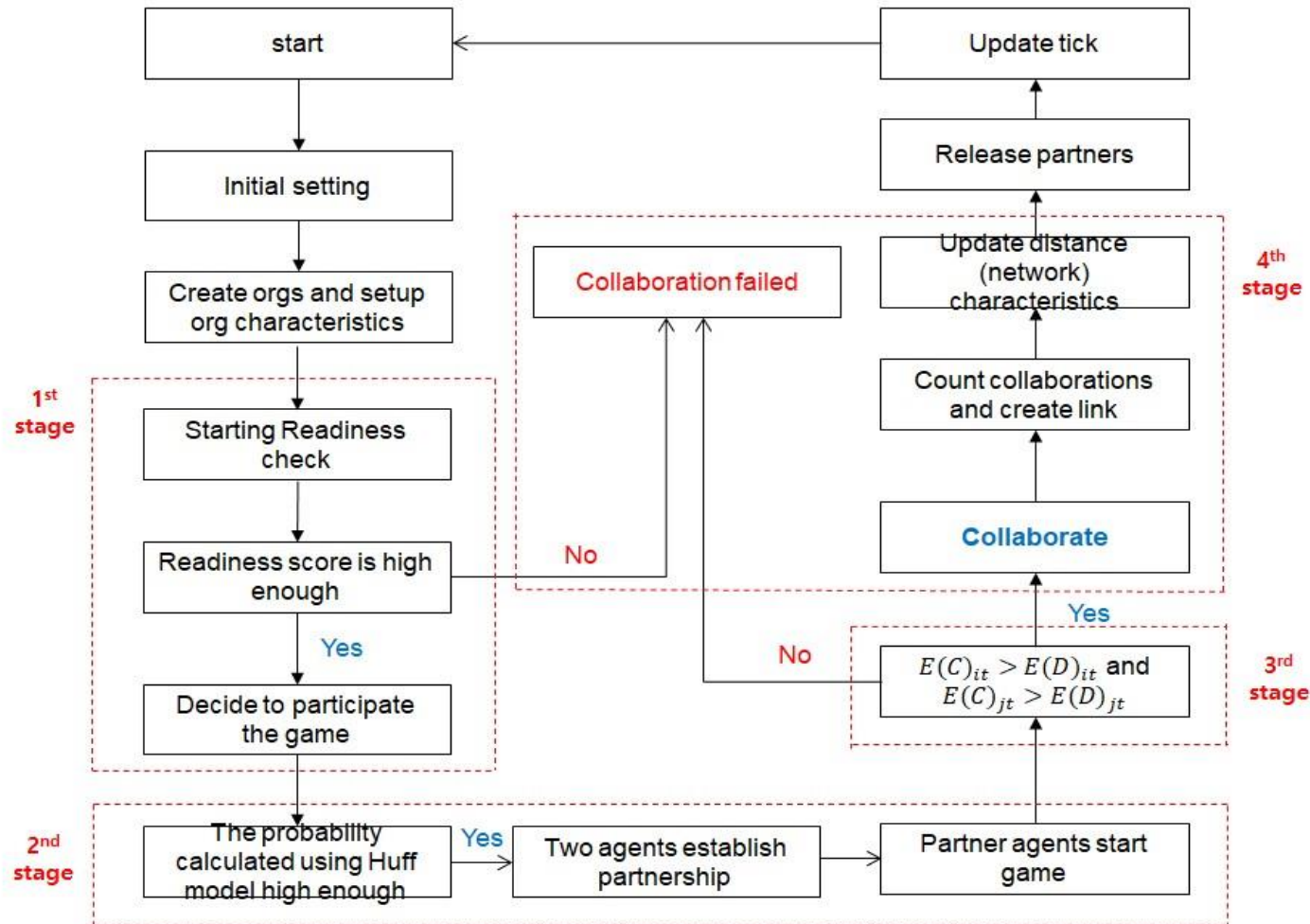
01 Process of Structuring mechanism



02 Structuring Mechanism



02 Structuring Mechanism



03

Defining Sub-models

Readiness (1st stage)

- Deciding whether participate the game or not
- R_{ij} = readiness score of factor j of organization i
- If sum of $R_{ij} \geq$ certain level, then organization i will decide to search possible partners

- $R_{ij} = I_{ij} + E_{ij}$
- $I_{ij} = incentive_i + monitoring_i + leadership_i + budget_i + preference_i + weight_i$
- $E_{ij} = president_i + neighbor_i$

Partner selection (2nd stage)

- Seeking and selecting possible partners
- P_{ij} = probability that organization i will meet organization j
- P_{ji} = probability that organization j will meet organization i
- If $P_{ij} + P_{ji} >$ certain level, then organization i and organization j will meet

- $N =$ a set of competing organizations
 - S_j = attractiveness of organization I
 - $S_j = incentive_i + monitoring_i + leadership_i + budget_i + preference_i + weight_i$
 - T_{ij} = network (psychological distance) between org i and j
- $$P_{ij} = \frac{\frac{S_j}{T_{ij}}}{\sum_{j=1}^N \frac{S_j}{T_{ij}}}$$

BC calculation (3rd stage)

- Calculate the expected benefit of collaborative behavior $E(B)_{it}$ and cost $E(C)_{it}$ at time t of organization I
- Benefit and Cost are measured using different scenarios depending on the types of collaborative behavior (Collaboration, Cooperation, Coordination)

- $E(C)_{it}$ =Lost Opportunity cost
- $E(B)_{it}$ =estimated benefit of collaboration

Decision making (4th stage)

- If $E(B)_{it} > E(C)_{it}$, organization i will decide to collaborate
- The result is reflected in N_i in the 1st stage and T_{ij} in the 2nd stage
- If collaboration failed, $neighbor_i$, T_{ij} 10% reduction
- If collaboration succeed, $neighbor_i$, T_{ij} 10% rise

- If $E(B)_{it} > E(C)_{it}$ and
- $E(B)_{jt} > E(C)_{jt}$
- collaboration

03 Defining Sub-models (1): readiness

- If sum of (survey) score of readiness (R_{it}) is greater than 'certain level', the organization i will decide to participate the game and search partners
- 'Certain level' will be decided by considering the distribution of survey data
- $R_{it} = I_{it} + E_{it}$
- $I_{it} = (\text{incentive}_{it} + \text{monitoring}_{it} + \text{leadership}_{it} + \text{budget}_{it})/4$
- $E_{it} = (\text{president}_{it} + \text{neighbor}_{it})/2$
- To calculate neighbor_i , convert the sum of the network strengths (frequency of contact) of organization i with other 46 organizations

03

Defining Sub-models (2): partner selection

- N = a set of competing organizations
- S_j = attractiveness of organization j
- T_{ij} = network strength between org i and j

$$P_{ij} = \frac{\frac{S_j}{T_{ij}^a}}{\sum_{j=1}^n \frac{S_j}{T_{ij}^a}}$$

- $S_j = \text{trust}_j + \text{compassion}_j + \text{communication}_j + \text{information}_j + \text{authority}_j + \text{leadersupport}_j$
- T_{ij} = frequency of contact (will measure the network strength of organization i with other 46 organizations)
- If $P_{ij} + P_{ji} >$ certain level, then organization i and organization j will meet

03 Defining Sub-models (3): BC calculation

- $E(C)_{it}$ =Lost Opportunity cost of collaboration
- $E(B)_{it}$ =estimated benefit of collaboration
- If $E(B)_{it} > E(C)_{it}$ and
- $E(B)_{jt} > E(C)_{jt}$
- The counted collaborative behavior is reflected in T_{ij} in the 2nd stage and in $neighbor_i$ in the 1st stage
- If collaboration failed, $neighbor_i$ (1st stage), T_{ij} (2nd stage) 10% reduction
- If collaboration succeed, $neighbor_i$, T_{ij} 10% rise
- Repeated game
- Calculating and measuring various types of collaboration (cooperation, collaboration, coordination)

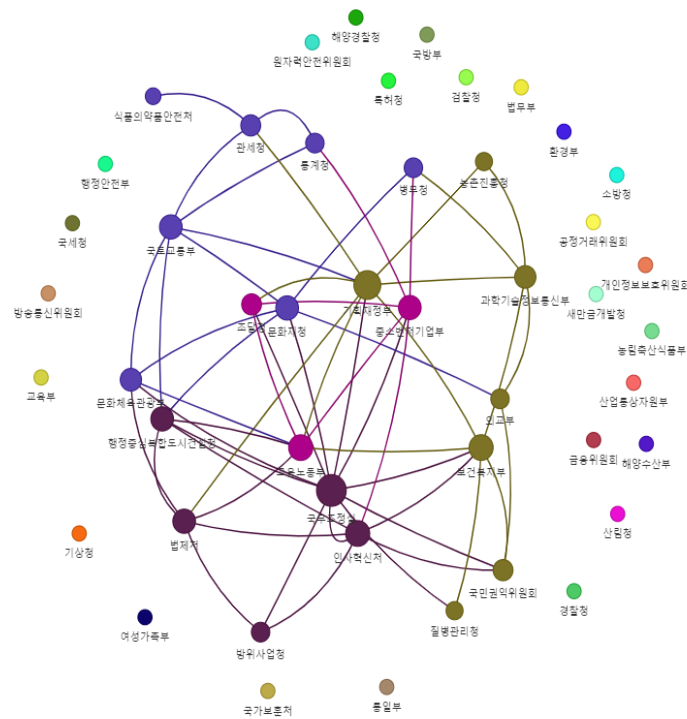
Chapter 4

Agent-based Modeling Simulation

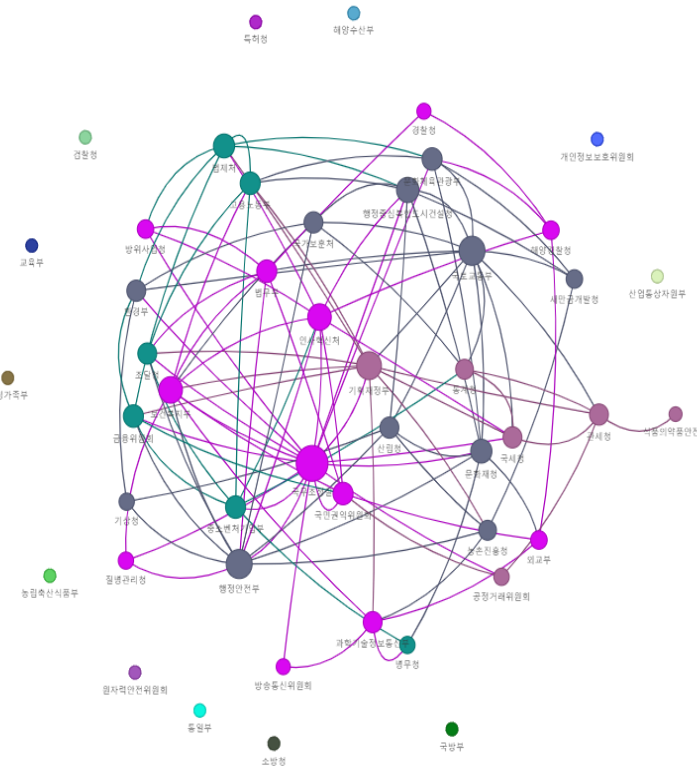


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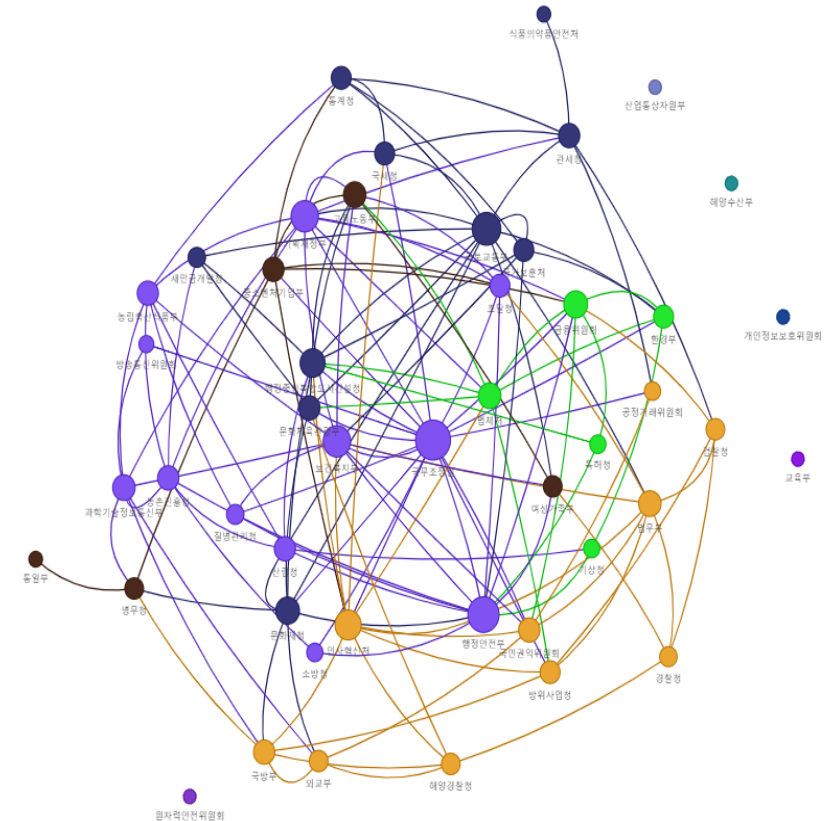
02 Structure of collaboration (1): External



- I (Internal)=100%
- E (External)=90%
- Tick=300



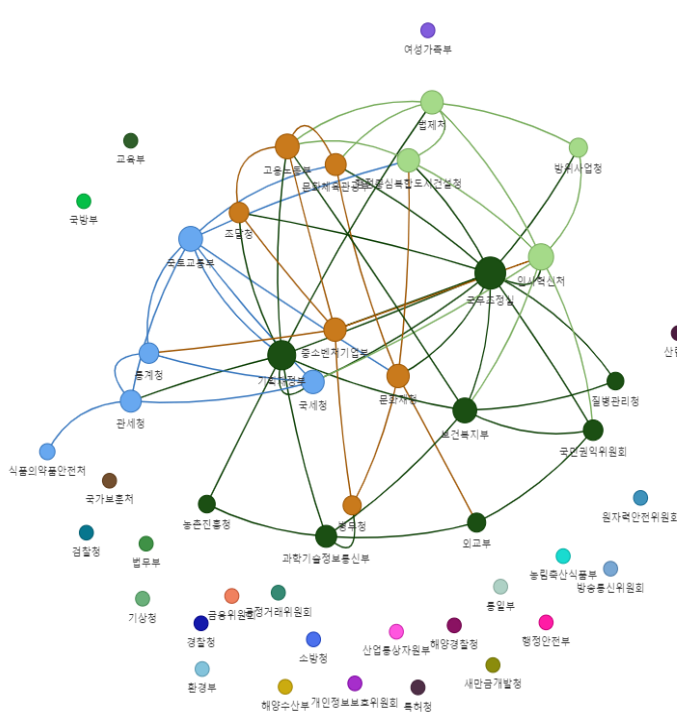
- I (Internal)=100%
- E (External)=100%
- Tick=300



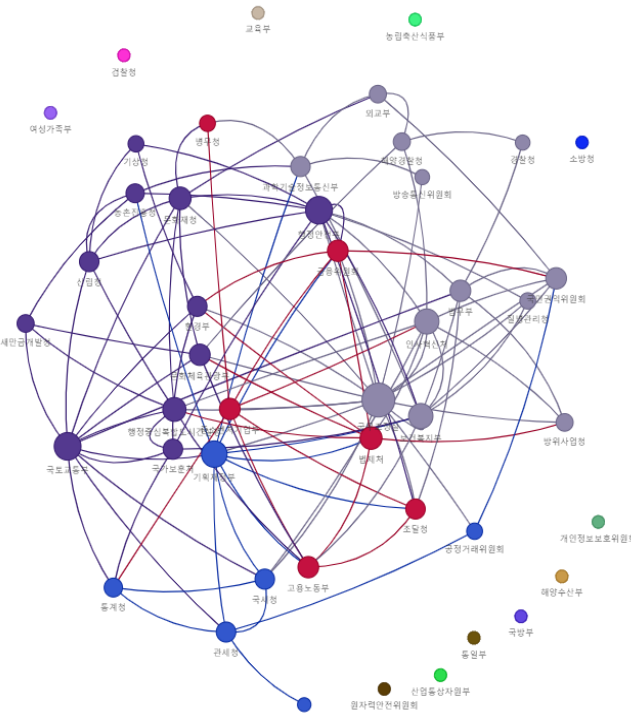
- I (Internal)=100%
- E (External)=110%
- Tick=300

02

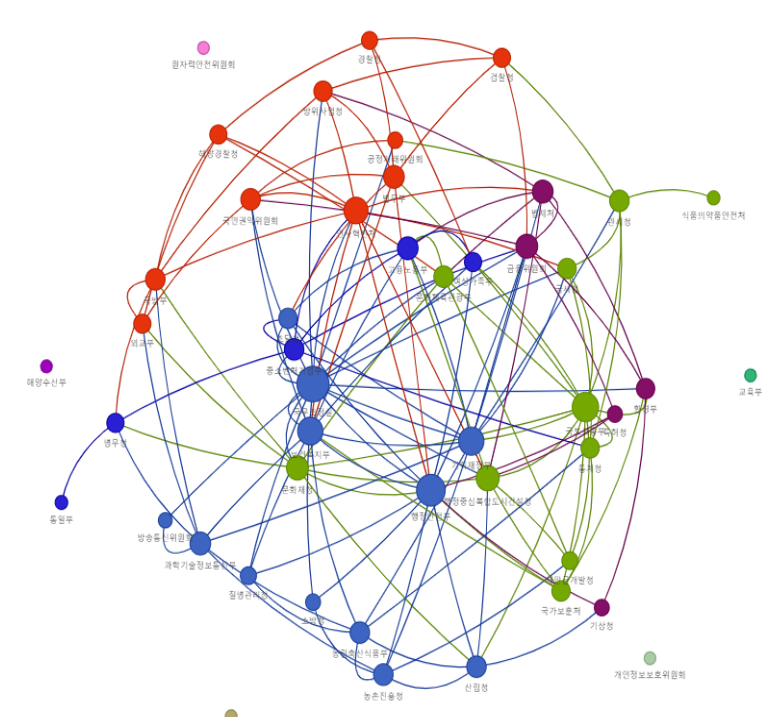
Structure of collaboration (2): Internal



- I (Internal)=90%
- E (External)=100%
- Tick=300



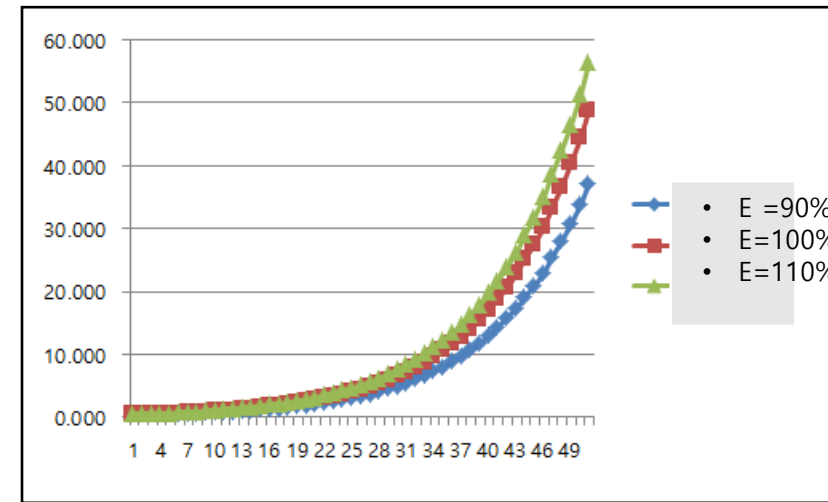
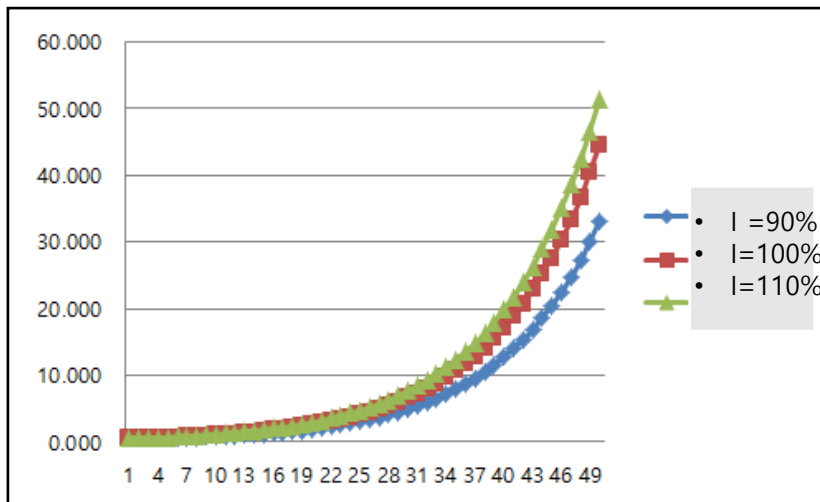
- I (Internal)=100%
- E (External)=100%
- Tick=300



- I (Internal)=110%
- E (External)=100%
- Tick=300

03

Strength of collaboration (1): External vs. Internal



- Strength of collaboration is stronger when External factors (E) is 110% than when Internal factors (I) is 110% (see the green graphs)
- Government organizations are more sensitive in External factors such as the support from the President's Office than the Internal factors

Chapter 5

Possible researches and Plans for the 2nd year study



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- **Data science**

- Call Detail Records (CDRs) for cell phone usages, combined with the demographic information, have helped reveal communication structure of people and the impact of the demographics on the communication patterns.
- Mobility datasets (e.g., LODES data of USA) have been analyzed to reveal human mobility patterns on the regional and inter-regional scales.

- **Network science**

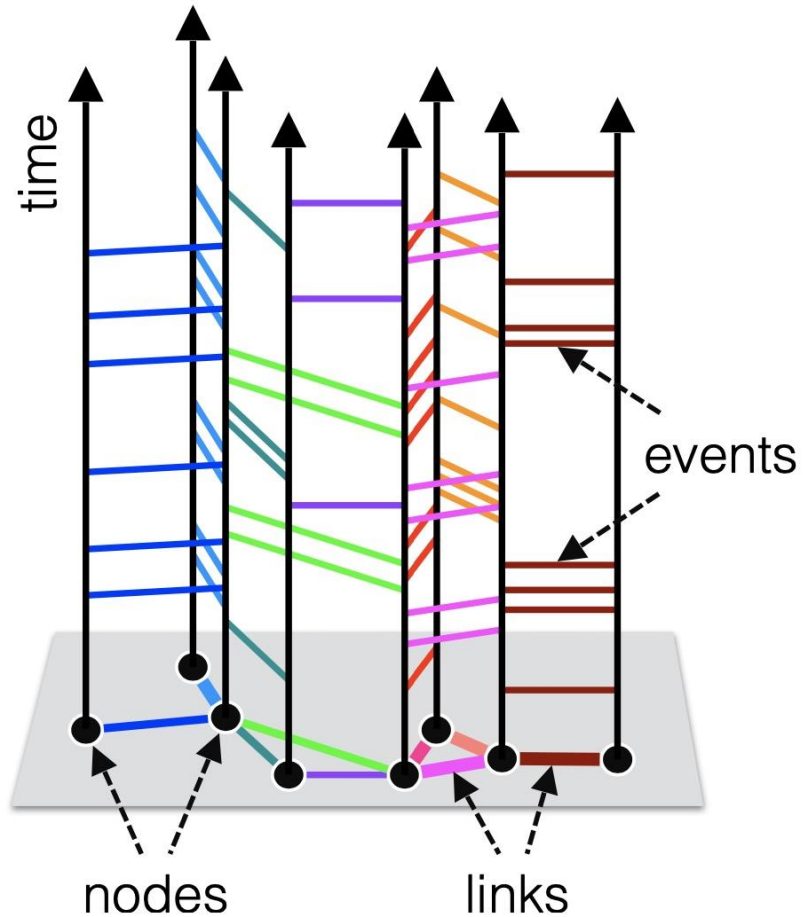
- Network = nodes + links
- Recent focus on temporal networks that can be seen as either time series of network or network of time series.
- Analysis of the temporal patterns can help “predict” the future of the system (e.g., link prediction for spreading of COVID-19).

- **Implication for policy-making**

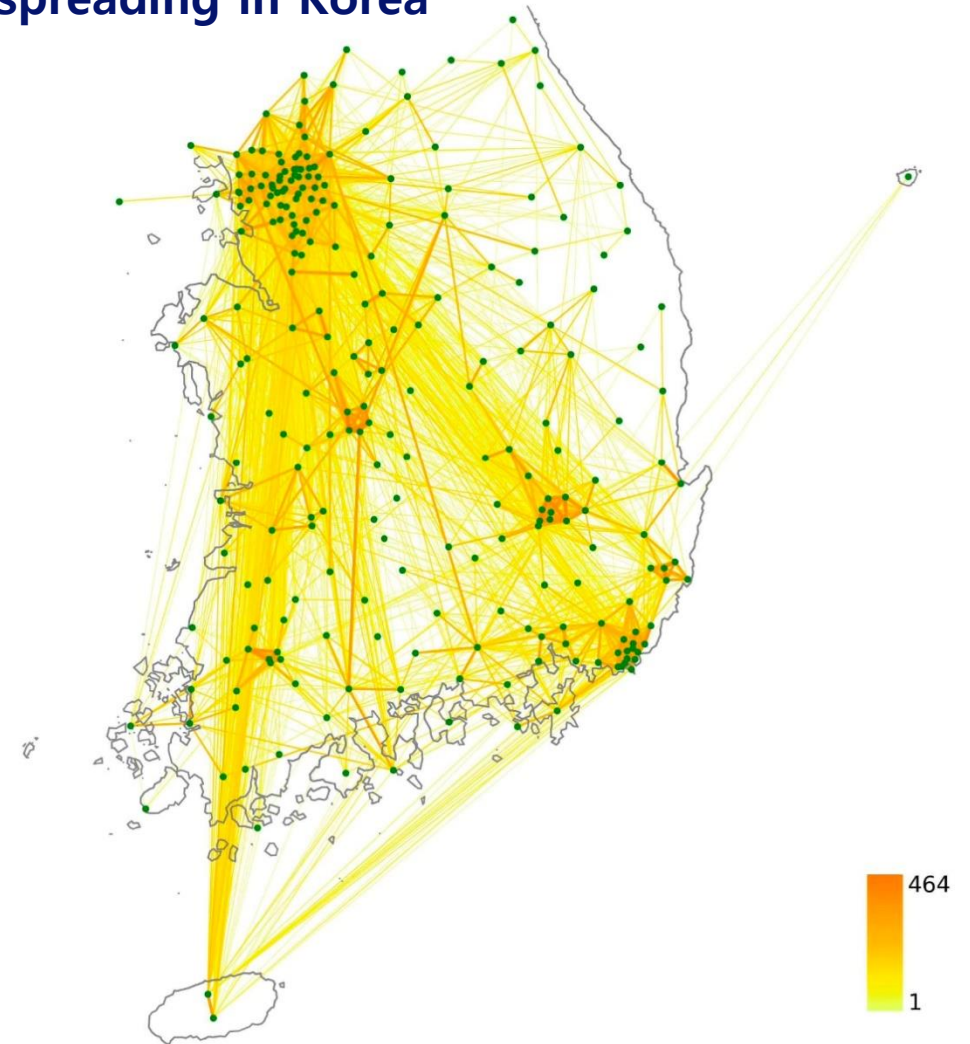
- Better policies based on understanding fundamental mechanisms of complex social systems and with help of computational model simulations?

- Other related topics by Hang-Hyun Jo

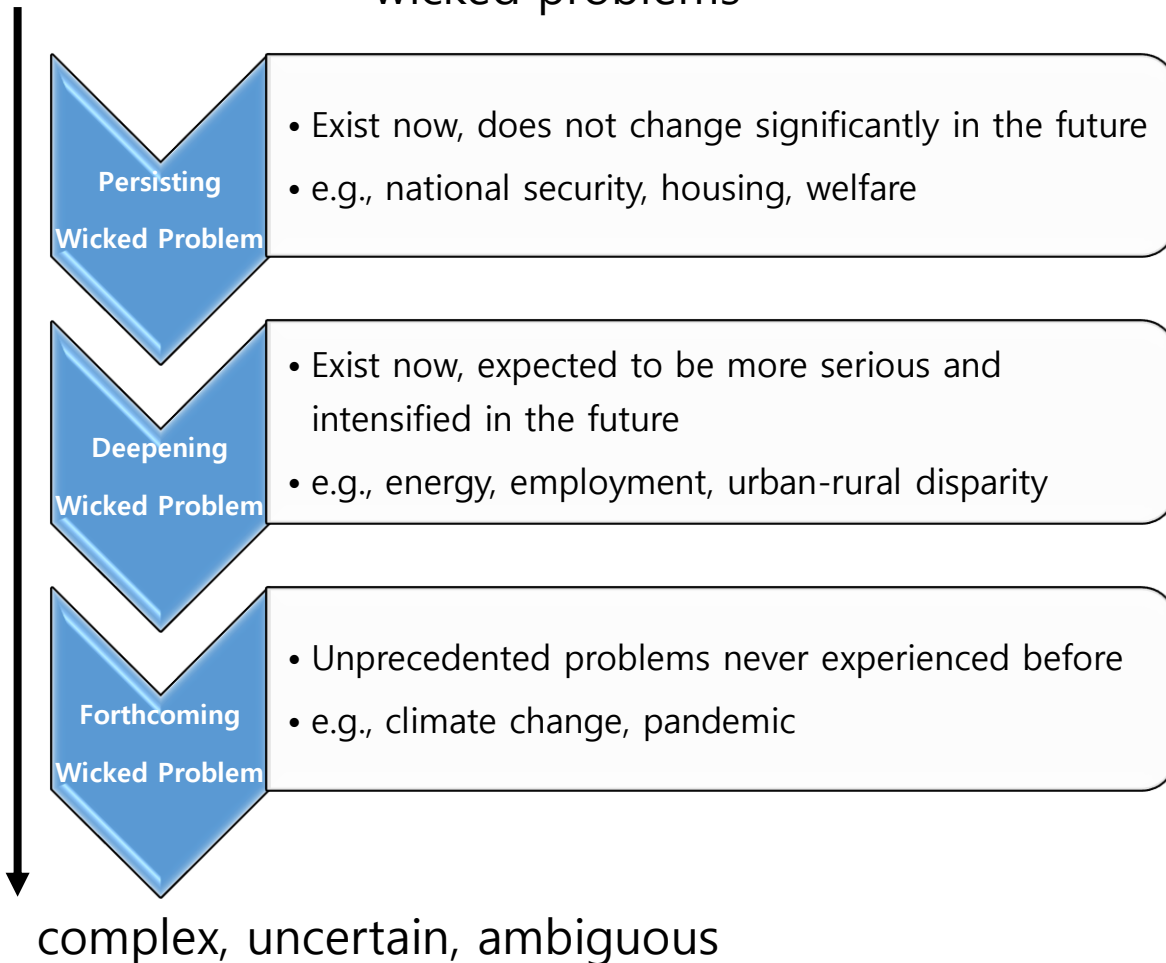
Temporal network



COVID-19 spreading in Korea



Step 1: Categorizing categorizing policy wicked problems



Step 2: Building

- Building and structuring algorithms for each type of policy wicked problems
- Selecting possible (various types of) agents, the process of decision-making based on in-depth interview
- Central government, local government, NGO, civil society, public firms

Step 3: Simulation

- Python-based simulation
- Will try to adopt various characteristics of collaboration
- Collaboration, cooperation, coordination..

THANK YOU



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