



# A Multi-dimensional Analysis to Societal Resilience in Context of COVID-19: A Systems Thinking Approach

Bijun Wang, Mo Mansouri, Onur Asan  
School of System and Enterprises  
Stevens Institute of Technology  
Hoboken, NJ USA

Presenter: Bijun Wang  
bwang27@stevens.edu



Presenter: Bijun Wang  
Email: [bwang27@stevens.edu](mailto:bwang27@stevens.edu)

Education:

- Ph.D. Candidate, Engineering Management, Stevens Institute of Technology, 2019-Present
- M.S. in Industrial and System Engineering, Rutgers University, 2016-2018
- M.S. in Statistics, Rutgers University, 2017-2018

Research Interests::

- System Resilience
- Human Factors
- Health Informatics
- Human-Technology Interactions
- System Dynamics Modeling
- AI-Human interactions in healthcare

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IEEE International Symposium on Systems Engineering

INCOSE International Symposium

IEEE International Conference of System of Systems Engineering (SoSE)

IEEE International Symposium on Systems Engineering (ISSE)





# Research Interests

Human-AI interaction







Health informatics

Systems thinking and resilience

Human factors in healthcare

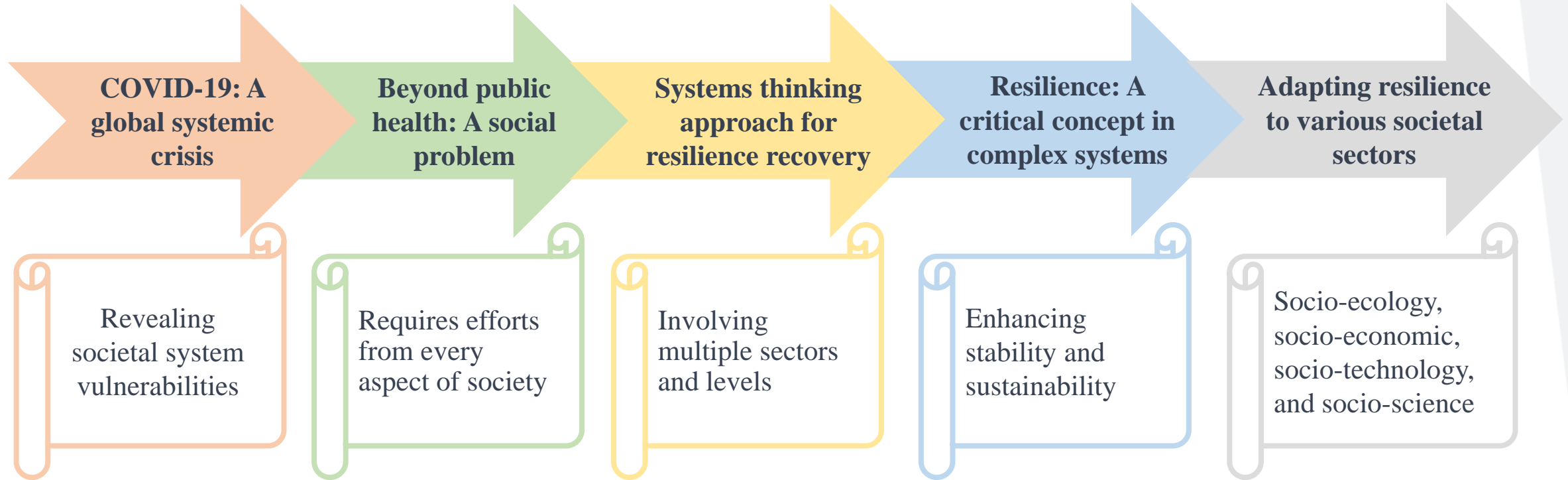
Link of the Human Systems Interaction Lab (Director: Dr. Onur Asan): <https://www.humansystemsinteractionlab.com/>

# Agenda

-  Introduction to Societal Resilience and COVID-19
-  Complexity of Systemic Resilience
-  Importance of Socio-Technical Systems
-  Examining Interrelationships: Macro, Meso, and Micro Levels
-  Spatial-Temporal Resilience Stages: policymaking at Different Spatial-Temporal Dimensions
-  Conclusion and Future Implications

# Introduction

---Societal resilience and COVID-19



# Complexity of Systemic Resilience

---Resilience: More Than a Single System Feature

## Complex societal systems

- Non-linear changes and interconnected systems and networks
- Emergent properties of complex societal systems

## Evolution of resilience

- Interaction and interdependency of systems and environments
- Challenges in identifying dynamic

## Consequences of overlooking interconnectedness

- Increased vulnerabilities to systemic shocks
- Interconnected effects of advanced technologies

## Disruption of balance and normalcy

- Resulting from tightly connected systems
- Need for considering broader implications in decision-making



# Complexity of Systemic Resilience

---Resilience: More Than a Single System Feature

## Resilience within and beyond single systems

- Interconnection with economic, supply chain, governance, and other systems
- Complexity of policymaking and pressure on healthcare systems

## Interdependence of human behavior, supply chain, transportation systems and other sub-systems

- Impact on healthcare system functioning during the pandemic
- Balancing quality of life and transmission risks

## System complexity driving societal development and adverse effects

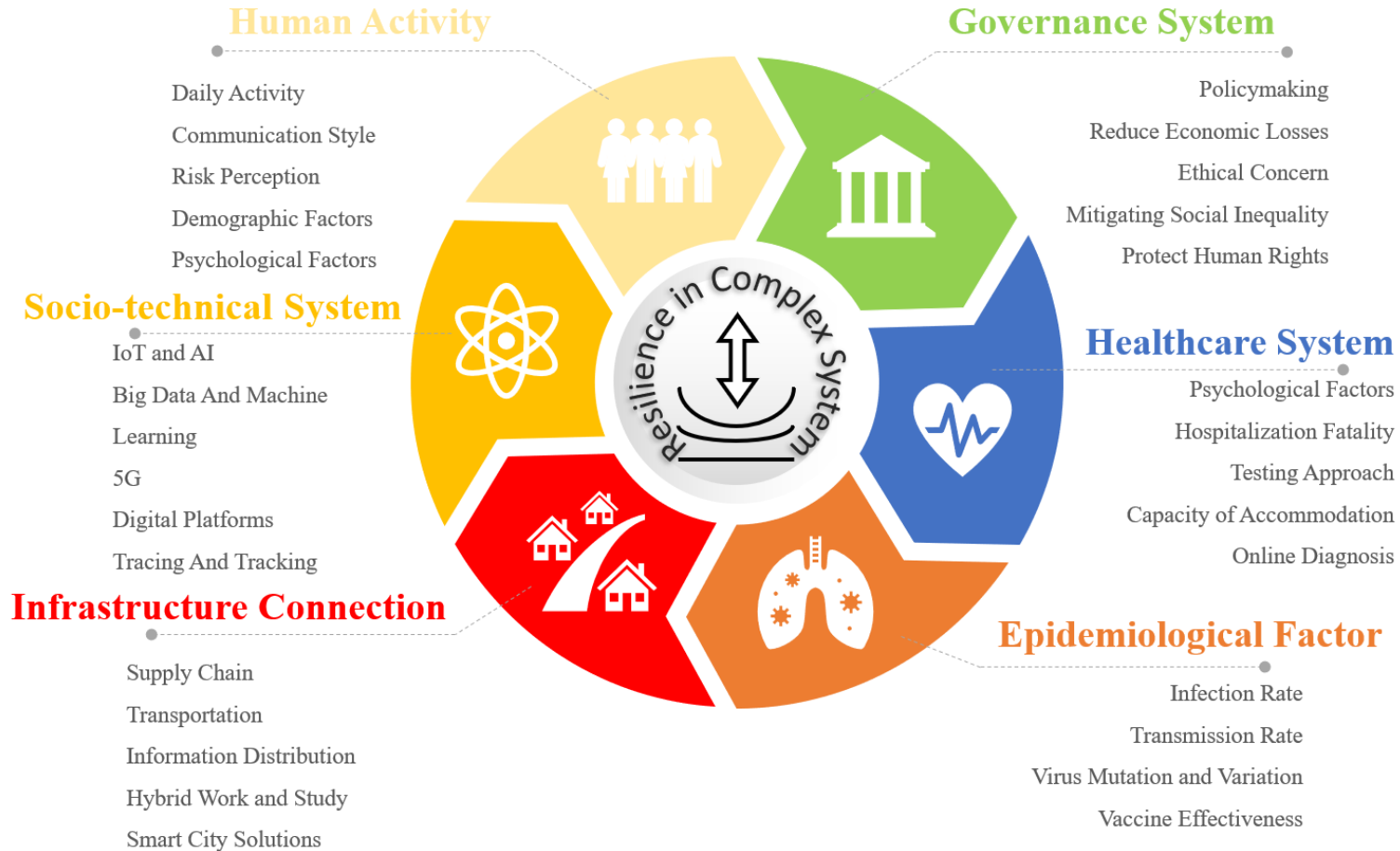
- Need for resilient policies considering interconnected systems
- Potential for system failure due to cascading adverse effects

## Society as a complex system of multiple subsystems

- Governance, epidemiological factors, human activity, healthcare, socio-technical systems, and infrastructure
- Resilience driven by both positive and negative outcomes

# Complexity of Systemic Resilience

--The interconnections and interactions in Complex societal system resilience facing to COVID-19





# The Role of Socio-technical System Resilience under COVID-19



## A: Aligning Socio-technical System with Society 5.0

- Importance of the socio-technical system in systemic resilience
- Society 5.0: integration of society, human factors, and technology

## B: Socio-technical System's Impact on Resilience

- Balancing positive and negative impacts
- Technology as a tool to enhance resilience





# Multi-Level Resilience Face COVID-19 Pandemic

## --Macro-level Resilience

- Emphasis on complex interconnected factors
- Maintains major societal functions during emergencies
- Retrieve resourcefulness and redundancy
- Allocates resources for crisis management and redundancy
- Top-down governance guidance for policy development
- Retrieve resourcefulness and redundancy
- Aims to maximize societal well-being during epidemics

### **Macro level resilience (society)**

Retrieve resourcefulness and redundancy to maintain major functionality of the whole society to sustain society normal operation facing the current and future shocks



# Multi-Level Resilience Face COVID-19 Pandemic

## --Meso-level Resilience

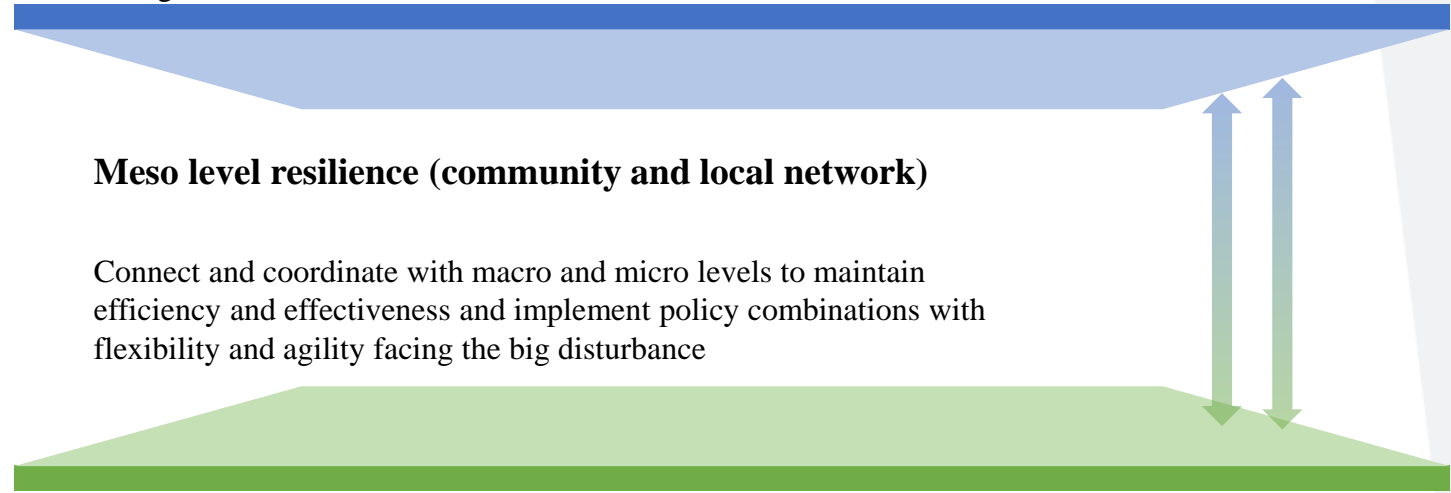
- Meso-level bridging macro and micro levels
- Flexible policy implementation
- Localized responsive governance
- Operational robustness and agility
- Tailored policies for local conditions
- Socio-technical system for communication

### **Macro level resilience (society)**

Retrieve resourcefulness and redundancy to maintain major functionality of the whole society to sustain society normal operation facing the current and future shocks

### **Meso level resilience (community and local network)**

Connect and coordinate with macro and micro levels to maintain efficiency and effectiveness and implement policy combinations with flexibility and agility facing the big disturbance



# Multi-Level Resilience Face COVID-19 Pandemic

## --Micro-level Resilience

- Individual and family-level well-being
- Mental health impacts of COVID-19
- Adapting behavior to the changing environment
- Socio-technical system feedback
- Interacting with changes due to crises and disruptions

### Macro level resilience (society)

Retrieve resourcefulness and redundancy to maintain major functionality of the whole society to sustain society normal operation facing the current and future shocks

### Meso level resilience (community and local network)

Connect and coordinate with macro and micro levels to maintain efficiency and effectiveness and implement policy combinations with flexibility and agility facing the big disturbance

### Micro level resilience (individual and families)

Individual behavior continues to adapt and interact with the change of environment and situation facing the crisis and disruptions such as COVID-19

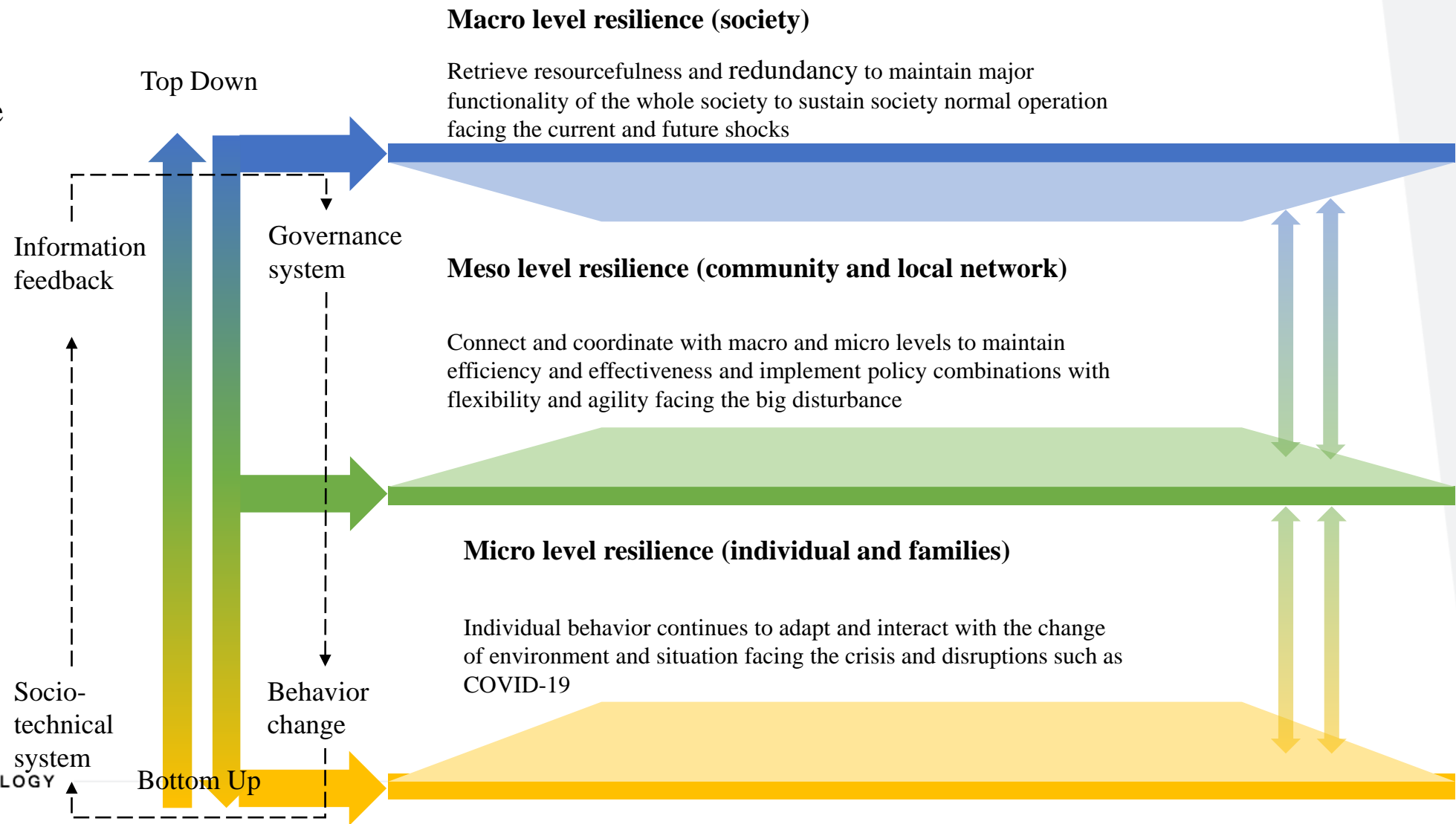


# Multi-Level Resilience Face COVID-19 Pandemic

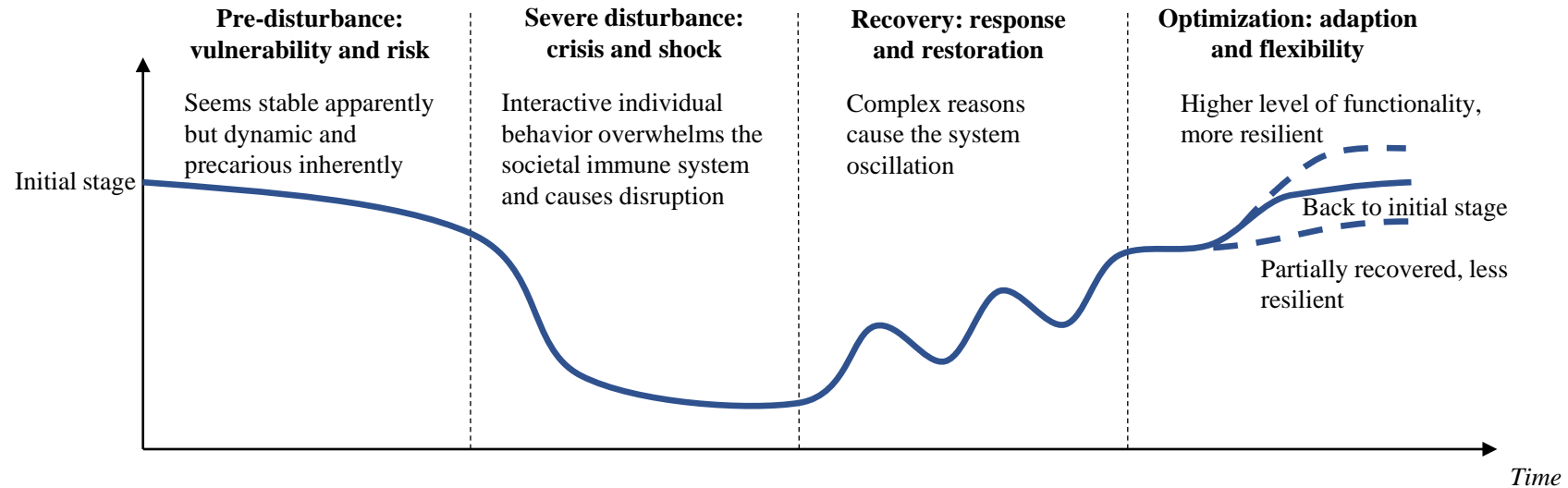
--Governance and Behavior Change

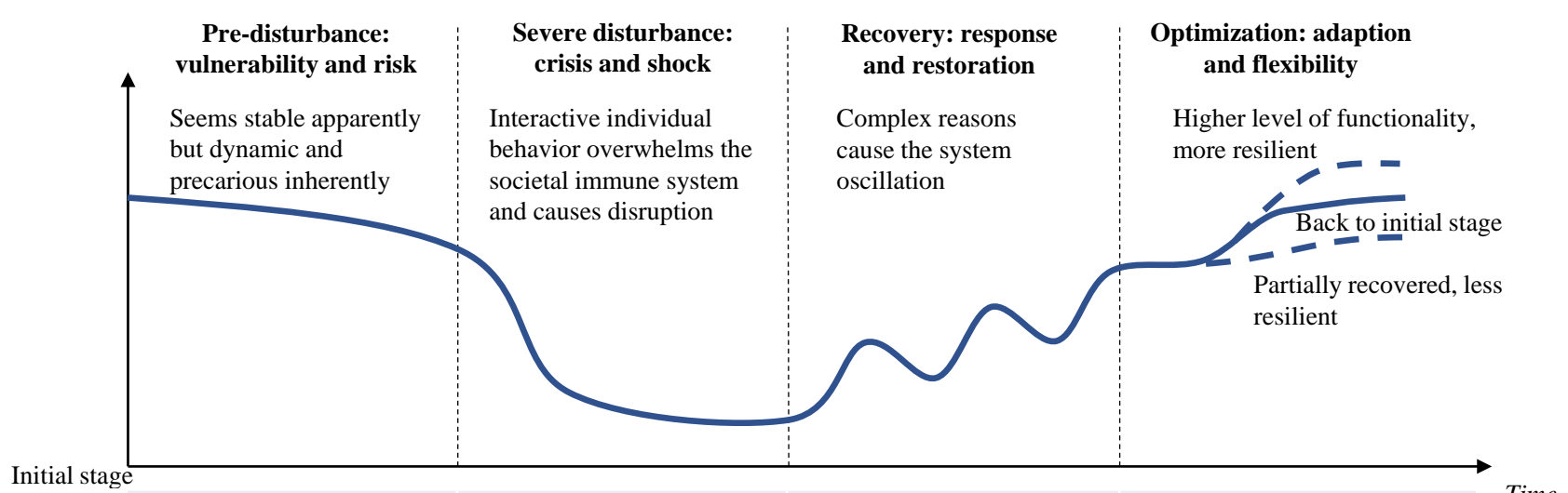


- Governance system
- Behavior change
- Socio-technical system
- Information feedback



# Resilience Stages: four stages





### Macro-level resilience

- Medical resources reservation
- Impact planning and analysis
- Healthcare demand estimation
- Response planning
- See the big picture
- Media publication
- Public Engagement

- Lift restriction for healthcare
- Evidenced decision making
- Leverage the power of socio-technical system
- Resources distribution
- Shorten resolution process during emergency

- Develop multi-level recovery framework
- Flexibility in policymaking
- Facilitate the business continuity
- Enhance public credibility
- Support for reopening

- Long term resilient plan
- Review and improve related policies
- Develop stimulus package
- Develop strategies for new waves of disaster
- Long-term consideration for society sustainability

### Meso-level resilience

- Develop communication channels
- Public education
- Medication distribution
- Information sharing
- Essential items restriction
- Dispel rumors

- Strong collaboration to connect each layer
- Coordinate health facilities, transportation and other sectors
- Set up vaccine sites
- Prevent large population gathering

- Provide mental health support
- Flexibility in policy execution
- Monitor and support local vulnerable population
- Implementation of recovery framework

- Strengthen community capacity for continues local support
- Continue operating key testing site and shelter
- Monitor and report the potential new wave of disaster
- Psychological health counseling

### Micro-level resilience

- Living resources planning
- Self-education
- Emotional preparation
- Maintain good communication with local governance system
- Risk perception

- Keep social distance
- Increase virtual communications
- Volunteer and community support
- Protect yourself and families
- Online education and work from home

- Preparing for back to work and school
- Continue personal safety protocol
- Request support for both health and financial difficulties
- Psychological adjustment

- Continues recovery of normal life
- Caution for potential new wave of disaster
- Build new resilience and Learn from disasters
- Maintain flexibility and adaptability

## Conclusion

- ❖ System resilience in disaster management and risk response
- ❖ Systems thinking approach for multi-level interactions and feedback
- ❖ Identifying vulnerabilities and strengths to inform policy
- ❖ Encouraging cross-sectoral collaboration
- ❖ Reducing functionality loss during crises (e.g., COVID-19)
  
- ❖ Paper limitations: lack of detailed case studies
- ❖ Future research: exploring policy combinations' impact on resilience stages
- ❖ Preparing for Future Crises: Lessons Learned from COVID-19





# THANK YOU

Bijun Wang  
[bwang27@stevens.edu](mailto:bwang27@stevens.edu)

**Stevens Institute of Technology**  
1 Castle Point Terrace, Hoboken, NJ 07030