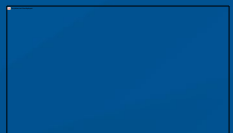




# “Towards a Resilient Future: Science, Technology, Policy and Private Sector Nexus for Disaster Risk Reduction”

02 – 03 October 2023  
Tunis - Tunisia





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المدرسة الوطنية لعلوم الإعلامية

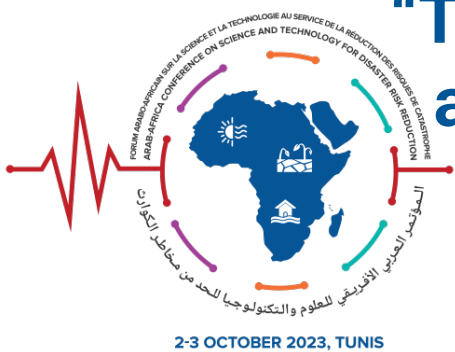


**Towards Resilience Assessment and improvement for disaster reduction:  
a concrete framework and case study**

**Plenary Session 2**

**“Towards a Resilient Future: Science, Technology, Policy  
and Private Sector Nexus for Disaster Risk Reduction”**

**02 October 2023 – Tunis - Tunisia**



2-3 OCTOBER 2023, TUNIS

## Key concepts ...

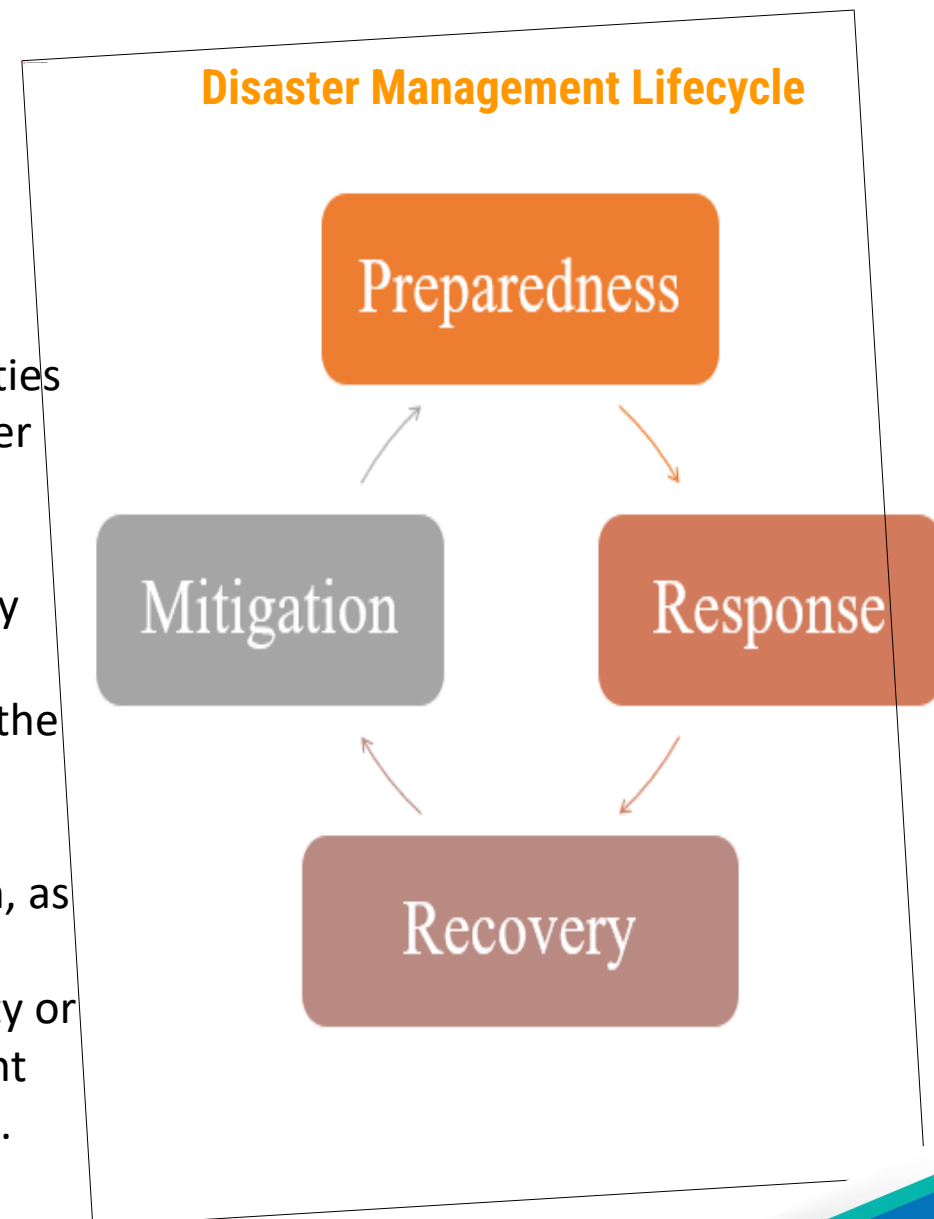
(cf. <https://www.undrr.org/terminology>)

**Preparedness:** The knowledge and capacities developed by governments, response and recovery **organizations**, communities and **individuals** to **effectively anticipate**, respond to and recover from the impacts of likely, imminent or current disasters.

**Response:** Actions taken directly **before**, **during** or immediately **after** a disaster in order to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

**Recovery:** The **restoring** or **improving** of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and “build back better”, to avoid or reduce future disaster risk.

**Mitigation :** The lessening or minimizing of the adverse impacts of a hazardous event.



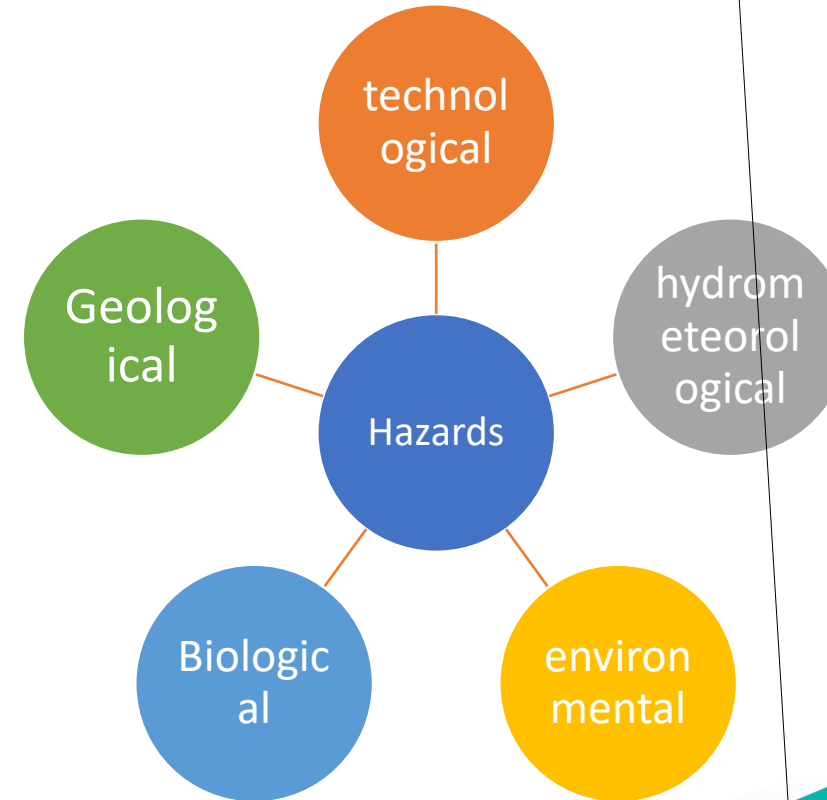
# What is resilience in the frame of DRR?

(cf. <https://www.undrr.org/terminology>)

**Disaster risk management:** is the application of disaster risk reduction **policies** and **strategies** to prevent new disaster risk, reduce existing disaster risk and manage residual risk, contributing to the **strengthening of resilience** and reduction of disaster losses.

**Resilience:** The ability of a **system**, community or society exposed to hazards to **resist**, **absorb**, accommodate, **adapt** to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic **structures** and **functions** through risk management.

processes & phenomena ... **complex socio-technical systems** ...  
human-centered



# What is the resilience of complex STS?

The **resilience** of an SST is the capacity of a system:

- to adjust its operation before, during or after **changes** and **disturbances**, so that it can maintain required operations under expected and unexpected conditions.
  - Resilience is the variability of the performance of an SST over time.
- ➔ STS management consists mainly in a continuous analysis and evaluation over time of the resilience of the organizations including all involved stakeholders and actors.

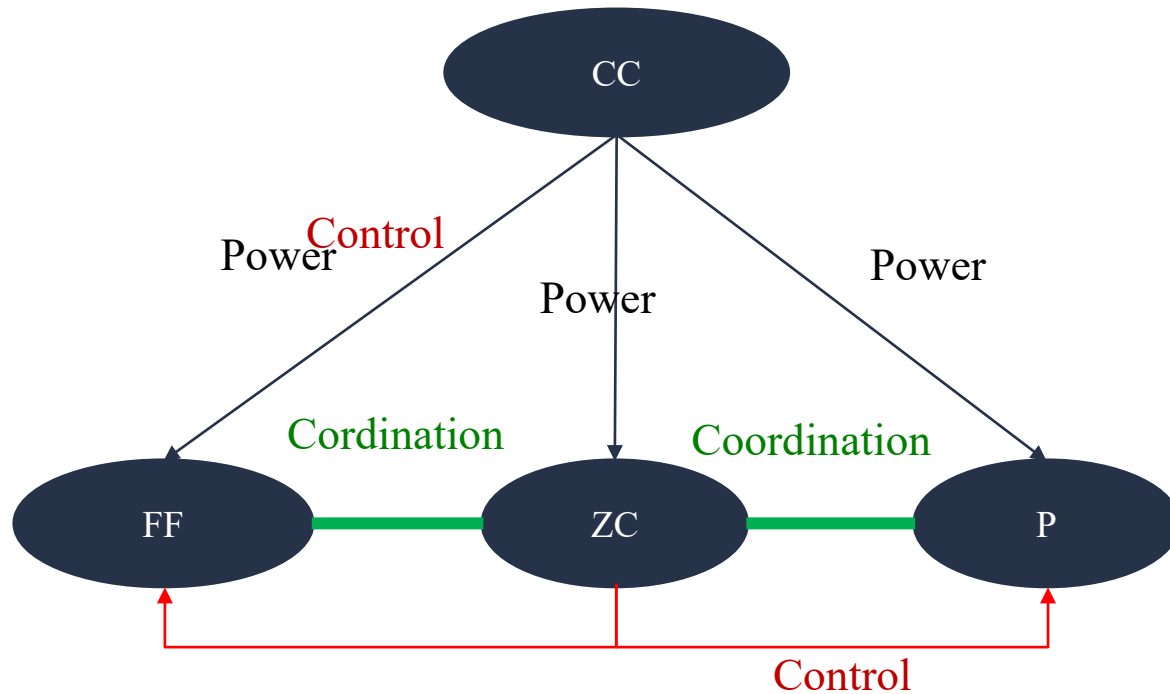
To analyze and monitor the resilience of STS, we must continuously **assess/measure** this resilience in order to support decision-makers



# Example of disaster management organization

3 three structural dimensions:  
coordination, power, and control

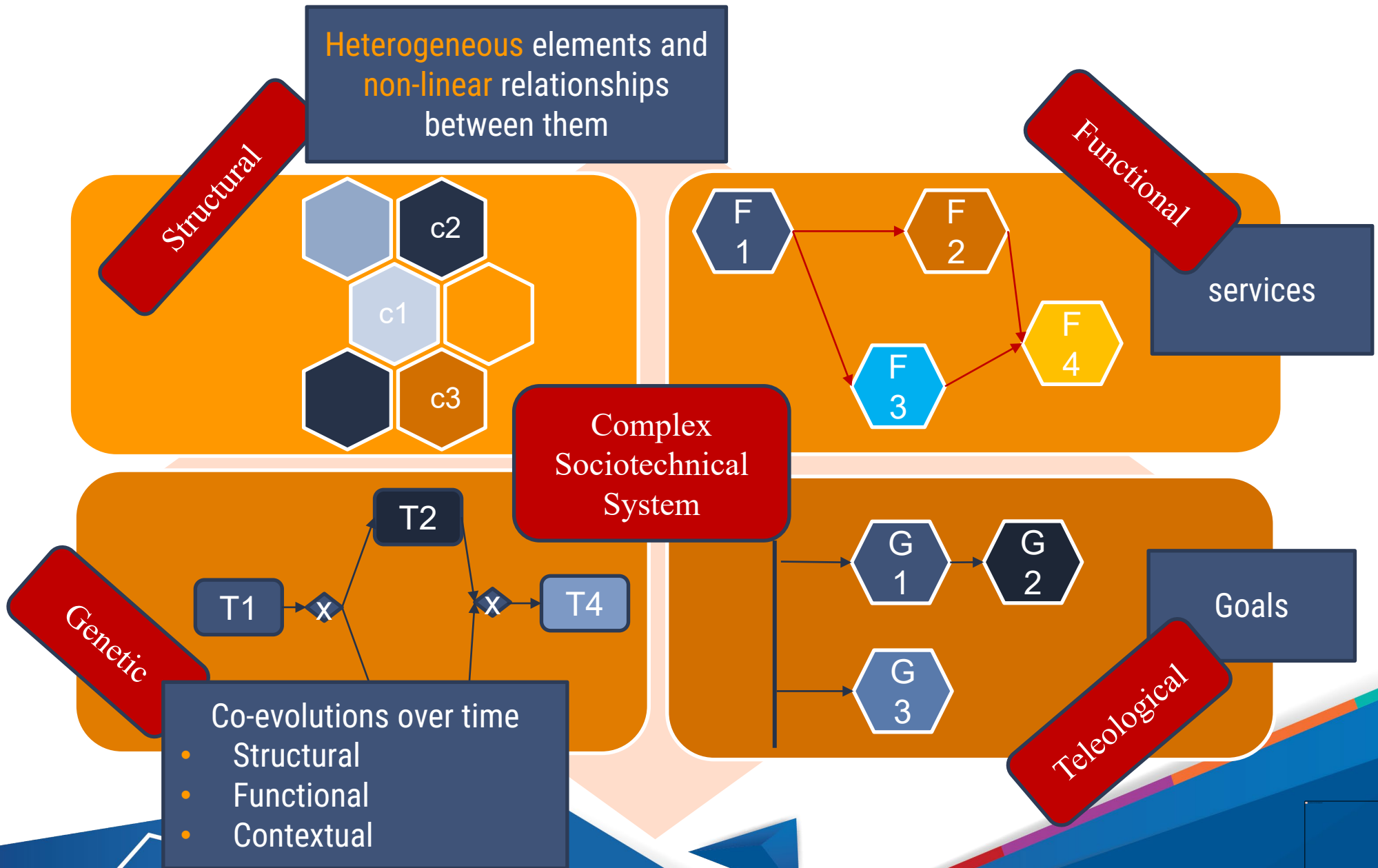
23 Actors



- CC Command Center (1)
- ZC Zone Chief (2)
- M Medics (5)
- AMPT Advanced Medical Post Team (1)
- FF Fire Fighters (5)
- P Police (6)
- N Nurses (3)

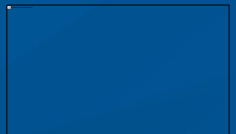
\* Inspired from Giordano, R; Pagano, A; Pluchinotta, I; del Amo, RO; Hernandez, SM; Lafuente, ES; (2017) Modelling the complexity of the network of interactions in flood emergency management: The Lorca flash flood case. Environmental Modelling & Software, 95 pp. 180-195.

# Holistic Modeling: structural / functional / genetic / teleological



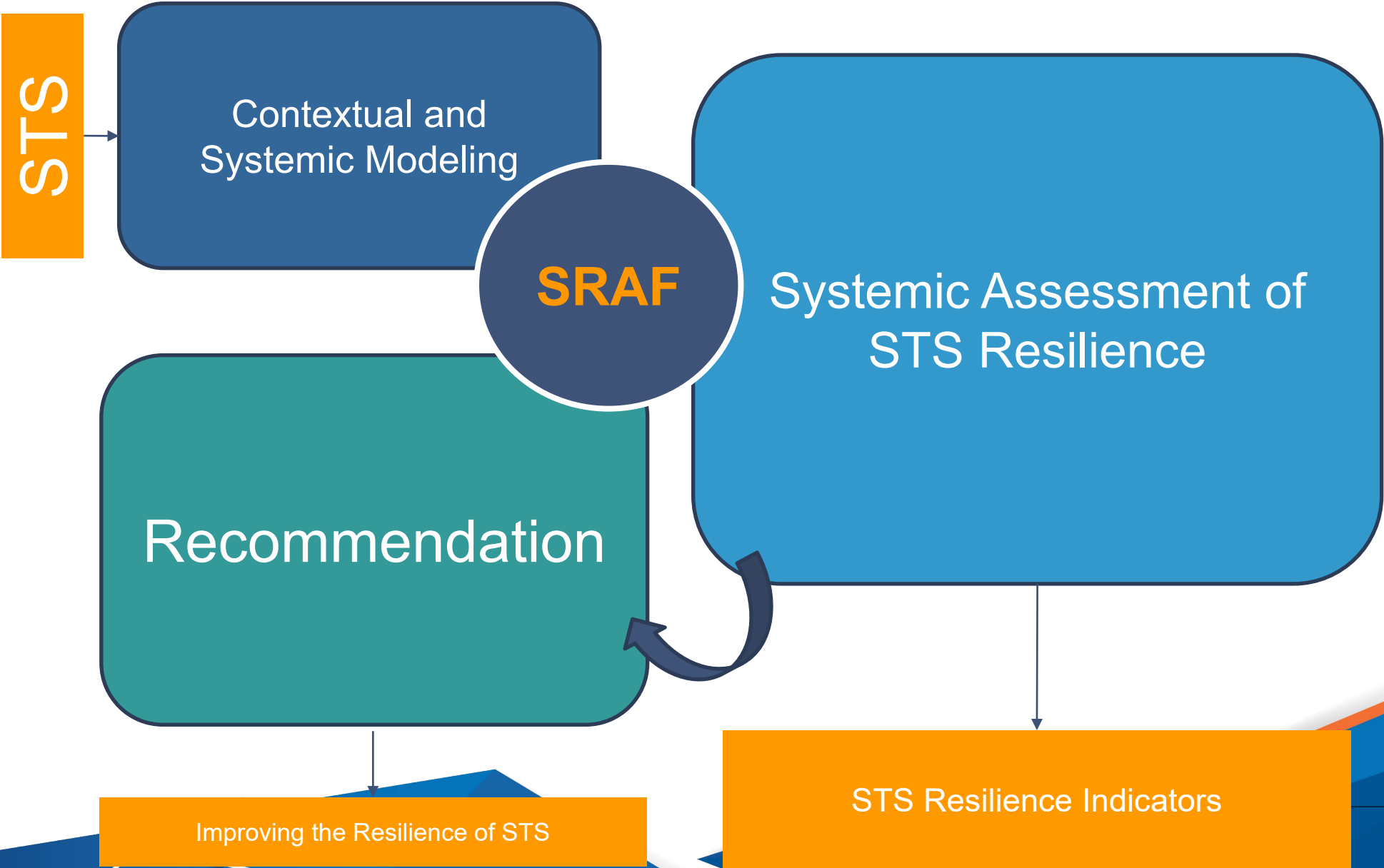
## Research issue:

How to evaluate **qualitatively** and **quantitatively** the **resilience** of a disaster management organization (i.e. complex STS)?

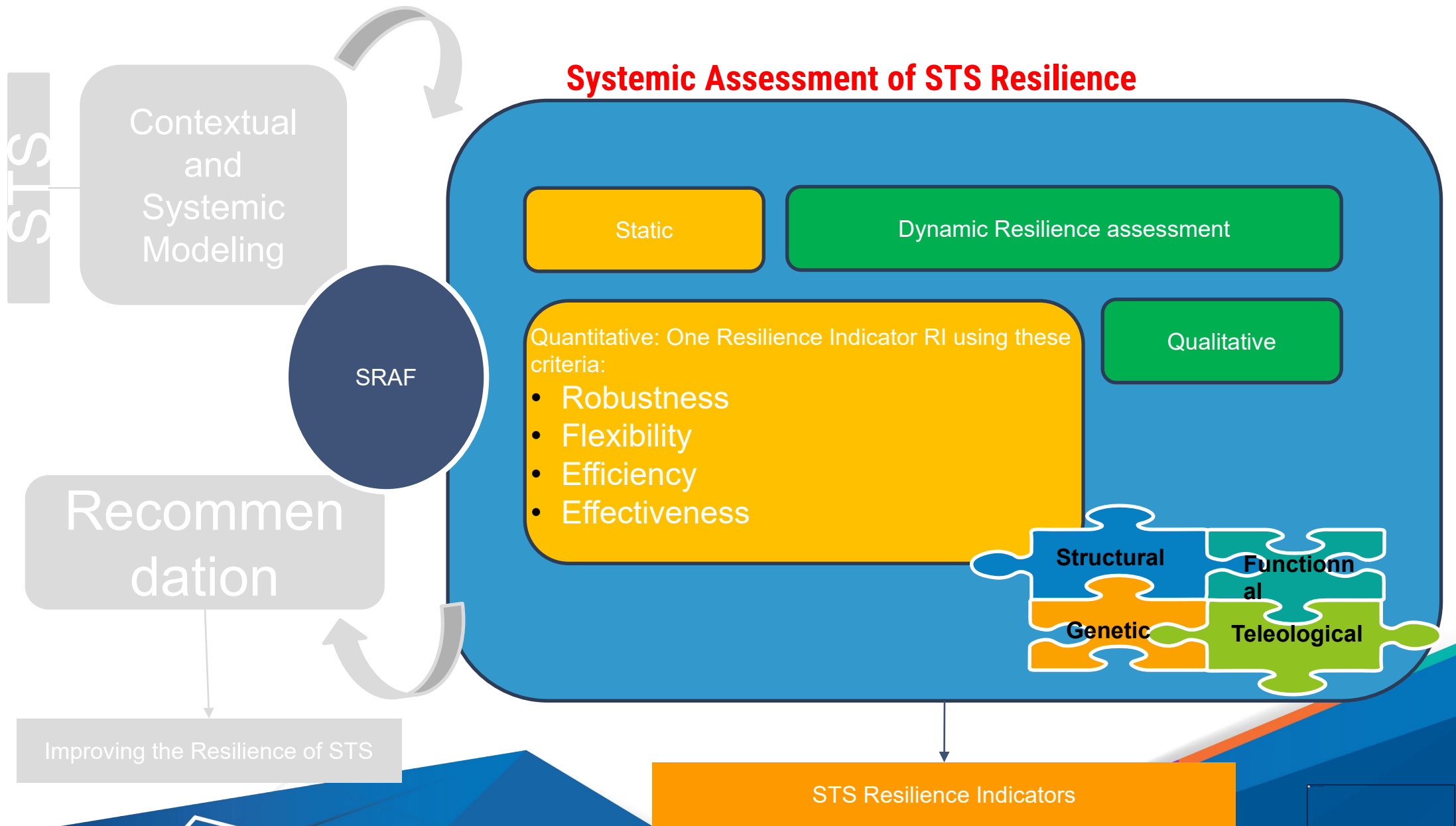


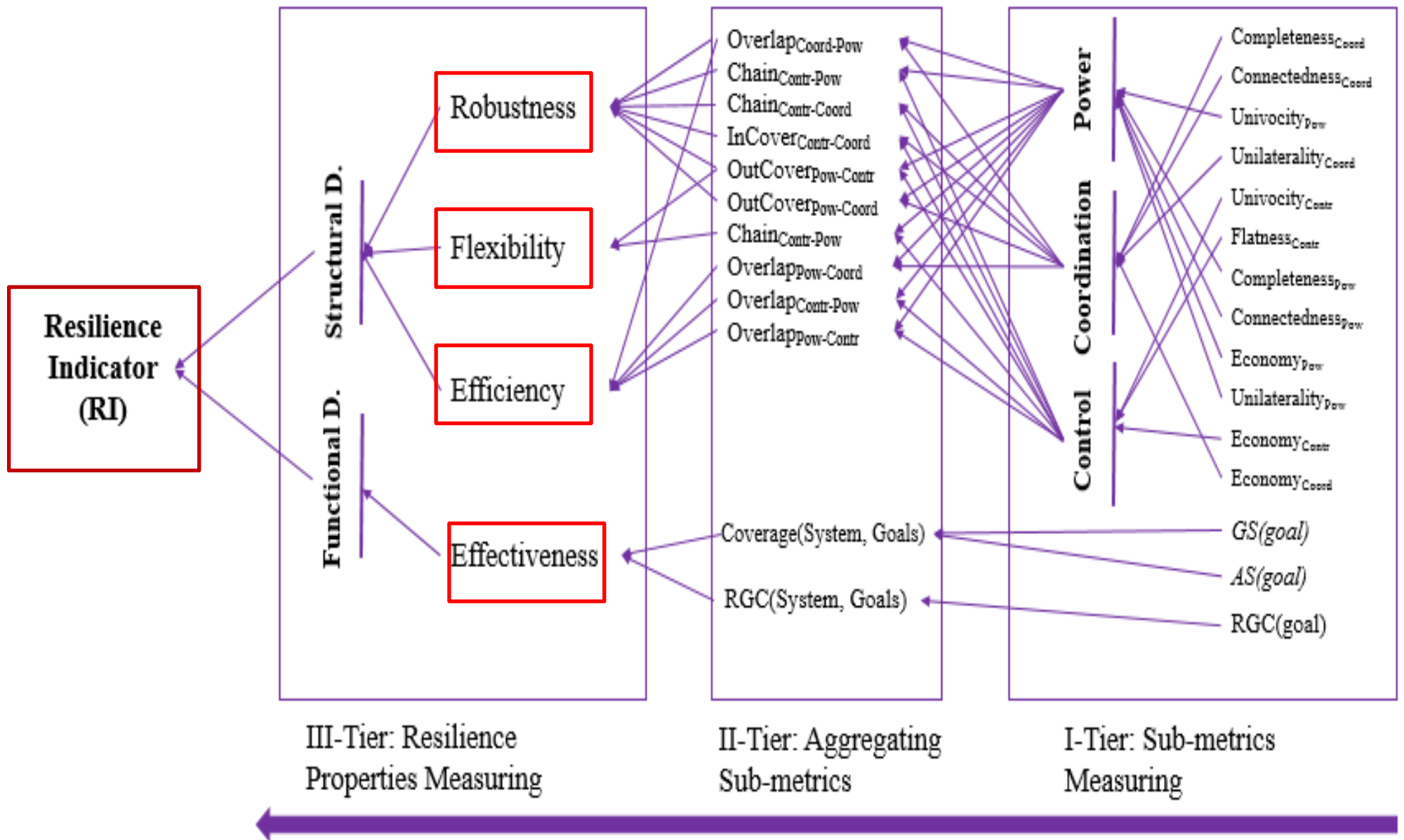


# Overview of the STS Resilience Assessment Framework (SRAF)



# SRAF - Qualitative & Quantitative measurements





# Case study

## Flood Disaster

**CC** 1 Command Center

**ZC** 2 Zone Chef

**M** 5 Medics

**AMPT** 1 Advanced Medical Post Team

**FF** 5 Fire Fighters

**P** 6 Polices

**N** 3 Nurses

Task	Organizational Structure	
	(Day 1)	(Day 2)
coordinate	(CC,1), (ZC,1)	(CC,1)
Health services	(M,1), (AMPT,1), (N,1)	(M,4), (AMPT,1), (N,2)
Evacuate people	(FF,2)	(FF,5)
Build dam	(P,6)	(P,0)
search	(M,1), (FF,2)	(M,4), (FF,5)

# Case study

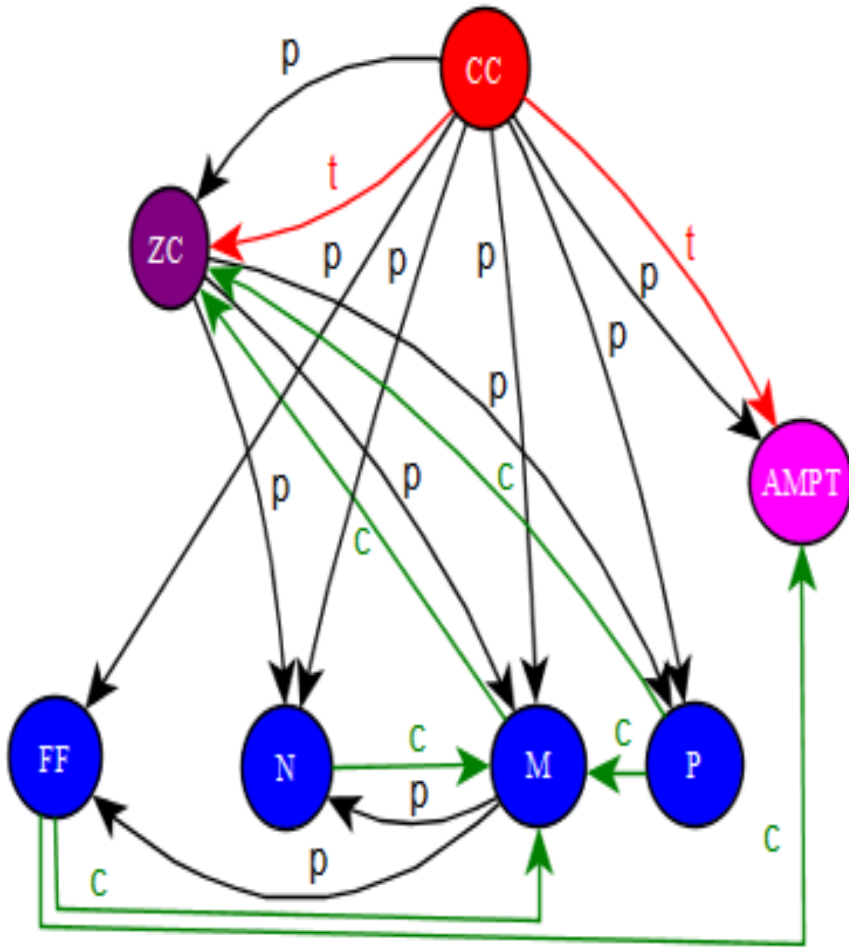


Fig. 6.a. Organizational Structure in day 1

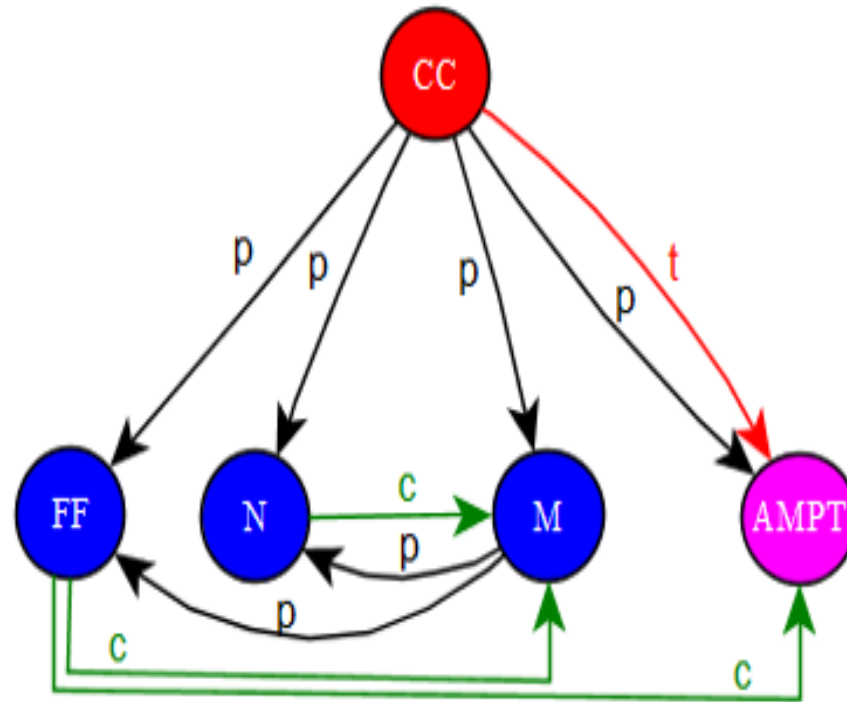


Fig. 6.b. Organizational Structure in day 2

# Case study

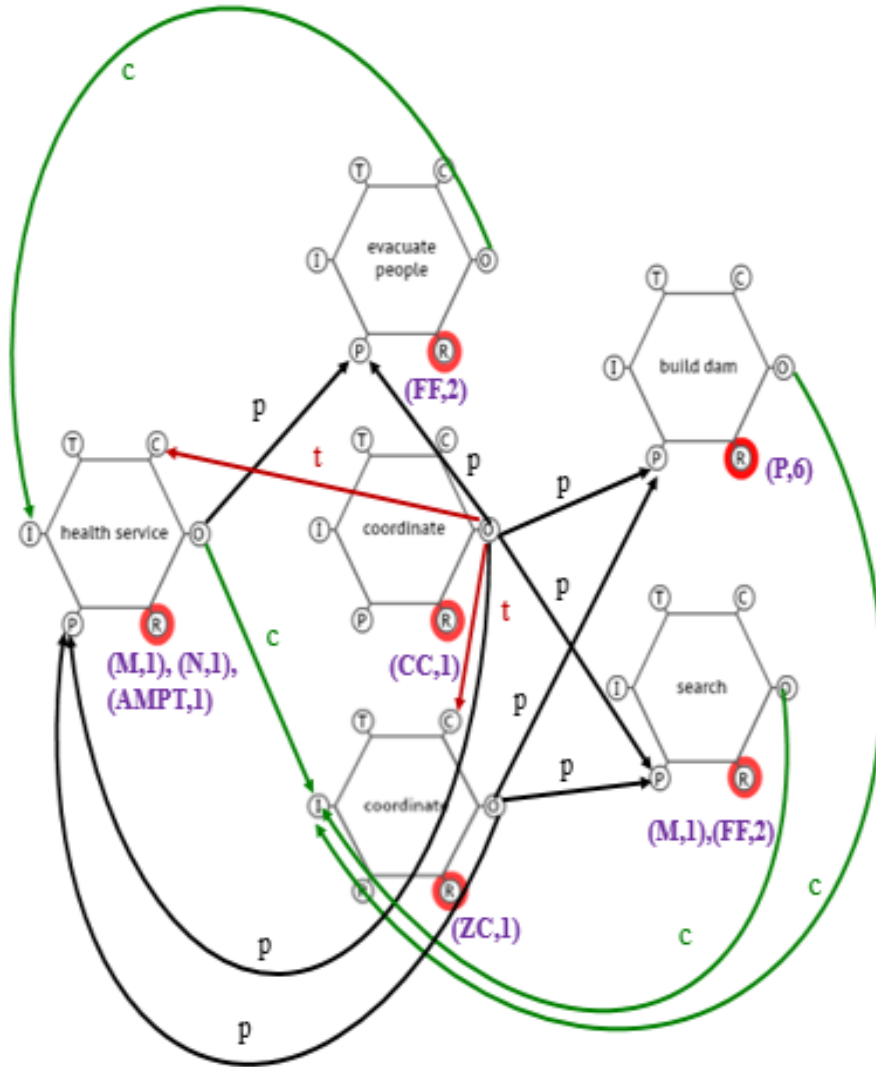


Fig. 5.a. Crisis FRAM Model in day 1

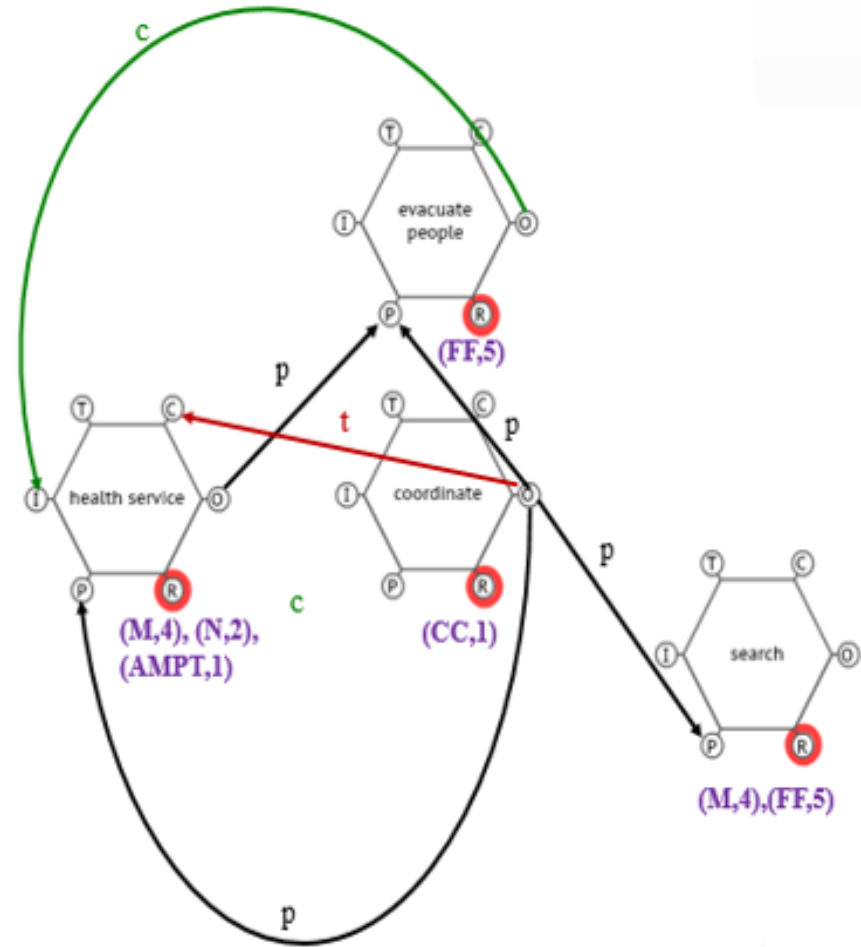


Fig. 5.b. Crisis FRAM Model in day 2

# Case study

		OS1 (day1)		OS2 (day 2)	
		Scenario 1 (20 victims)	Scenario 2 (50 victims)	Scenario 1 (20 victims)	Scenario 2 (50 victims)
Robustness		0,44	0,44	0,48	0,48
Flexibility		0,35	0,35	0,4	0,4
Efficiency		0,37	0,37	0,37	0,37
Effectiveness	simulation time (seconds)	235	551	175	242
	Number of actors	12	12	13	13
	Percentage of rescued victims	55	62	65	66
	Goals coverage(%)	100	100	66	66
Global Effectiveness		0,66	0,53	0,64	0,61
Performance Indicator		0,625	0,592	0,597	0,59

# Conclusions ...

- Developing a framework for assessment of resilience of Socio-technical systems is completely **in line** with the goal and targets of the Sendai Framework mainly “**enhancing disaster preparedness for effective response**”
- This **generic framework** can be largely developed and **effectively used as soon as concrete** field data and realistic scenarios are available
- **We** (researchers) **need** for sustainable **collaboration** with DRR stakeholders to advance the application of research results improving resilience in DRR
- **Together** we can accelerate the **implementation** of the Sendai Framework and its four priorities





## RESEARCH TEAM: RIADI – ENSI, Univ. Manouba

- Dr. Wissem ELJAOUED, Phd defended in June 2022,  
A qualitative and quantitative evaluation framework for resilience improvement of sociotechnical systems
- Dr. Nesrine BEN YAHIA, Assistant Professor, ENSI

In collaboration with Prof. Chihab HANACHI, IRIT, France

## RELEVANT PUBLICATIONS

- [1] Ben Yahia, N., Eljaoued, W., Bellamine Ben Saoud, N., & Colomo-Palacios, R. (2021). Towards sustainable collaborative networks for smart cities co-governance. *International Journal of Information Management*, 56:102037
- [2] Eljaoued, W., Ben Yahia, N., & Bellamine Ben Saoud, N. (2021). Systematic Literature Review on Sociotechnical Systems Resilience Assessment in a Holistic View, *ISD 2021*
- [3] Eljaoued, W., Ben Yahia, N., Bellamine Ben Saoud, N. (2020). A Qualitative-Quantitative Resilience Assessment Approach for Socio-Technical Systems. *KES 2020*, *Procedia Computer Science*, 176, 2625-2634
- [4] Eljaoued, W., Ben Yahia, N., Bellamine Ben Saoud, N., & Hanachi, C. (2019, June). A Hybrid Recommendation Approach for Agent Organizational Structures. In *2019 IEEE 28th International Conference on Enabling Technologies: Infrastructure for Collaborative Enterprises (WETICE)*



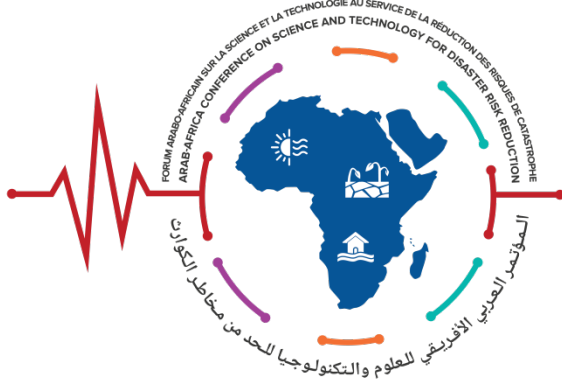


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ENSI core values

Excellence, Networking, Sustainability, Innovation



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THANK YOU – شكرا