

A Mesoeconomic Resilience Framework for Regional Assessment Studies

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The 49th Risk, Hazard & Uncertainty Workshop



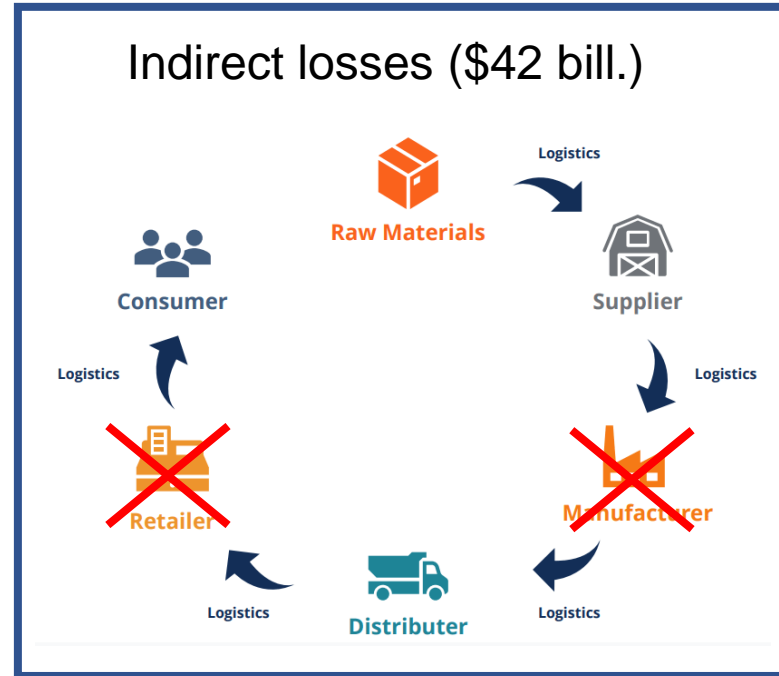
June 2023



Resilience under Multiple Hazards

..Total losses during Katrina hurricane (2005)

Direct losses (\$107 bill.)



Total losses (\$149 bill.)

Resilience under Multiple Hazards

Hazards on Cultural Heritage (CH) sites may affect **tourism** and thus can lead to severe **indirect losses**

Granada



Rhodes



Venice



Business sectors

Business sector is a **group of businesses** with similar economic activities



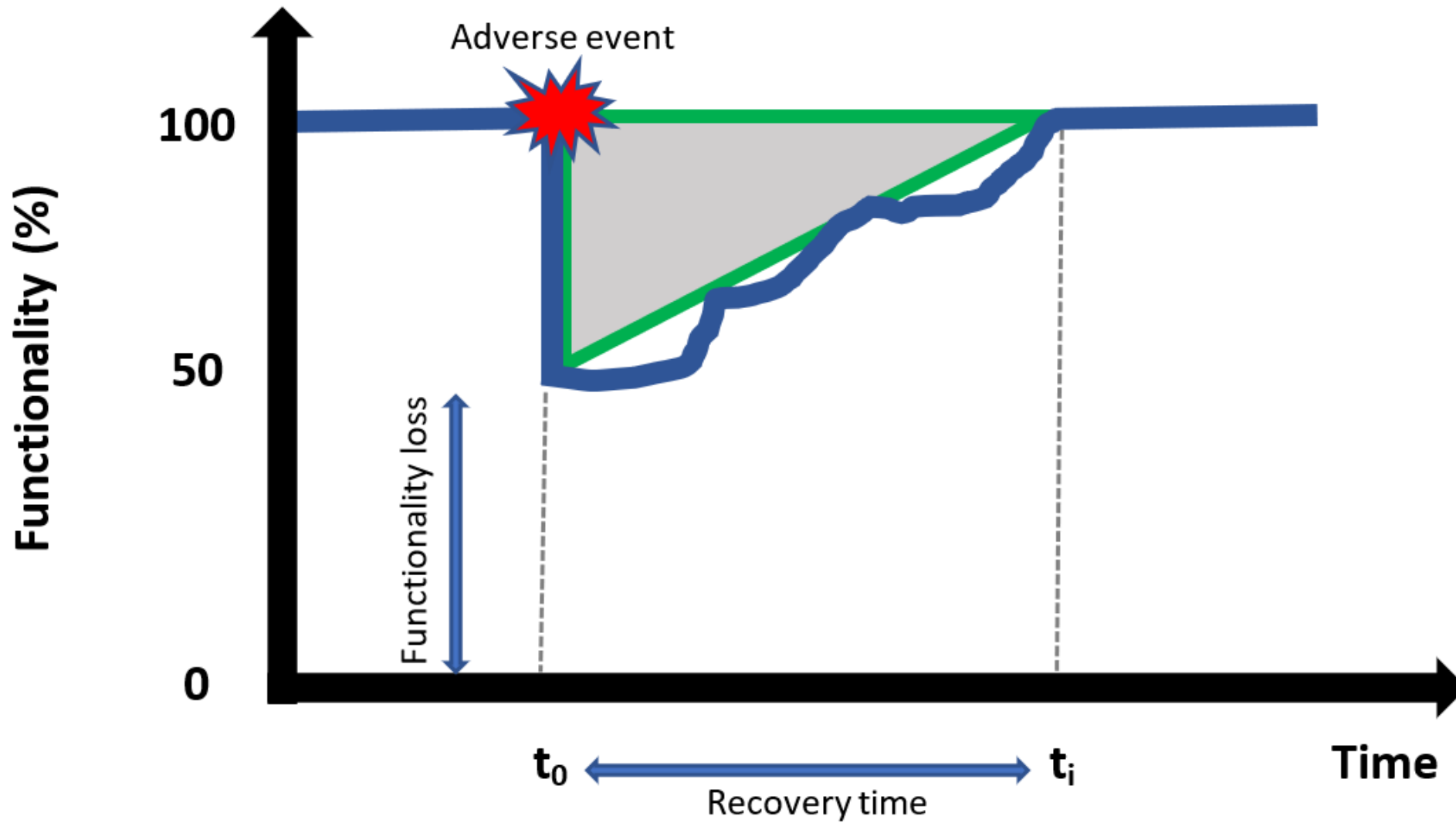
Business sectors

City of Rhodes

#	Full Name	GVA (€ mill.)	GVA (%)
1	Wholesale trade	112.80	13.81%
2	Real estate activities	93.99	11.51%
3	Retail trade	64.10	7.85%
4	Accommodation	60.15	7.37%
5	Food and beverage services	50.31	6.16%
6	Education	44.65	5.47%
7	Human health and social work activities	36.22	4.43%
8	Business, scientific and technical activities	33.77	4.13%
9	Warehousing activities	28.41	3.48%
10	Wholesale and retail trade motor vehicles	24.27	2.97%
11	Financial services and insurance activities	23.27	2.85%
12	Manufacturing	23.00	2.82%
13	Creative, arts and entertainment activities	20.18	2.47%
...
SUM		816.71	100%


Tourism is very important for Rhodes!

Data gathered from national and regional accounts



The post-event performance of business sector i is affected by:

- The extent of direct damages to the facilities of sector i (**Infrastructure Index**)
- Supply bottlenecks due to disruptions to other sectors that supply sector i (**Input Index**)
- Reduced demand by sectors and end-consumers that purchase goods/services from sector i (**Output Index**)


$$PerfIdx = \min(InfraIdx, InputIdx, OutputIdx)$$

PerfIdx: Performance Index

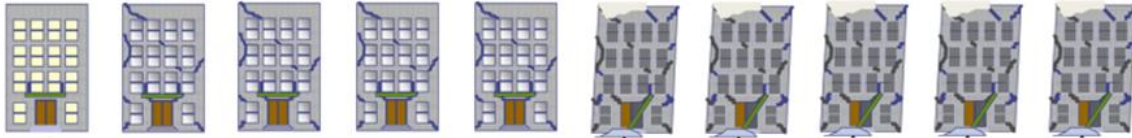
InfraIdx: Infrastructure Index

InputIdx: Input Index

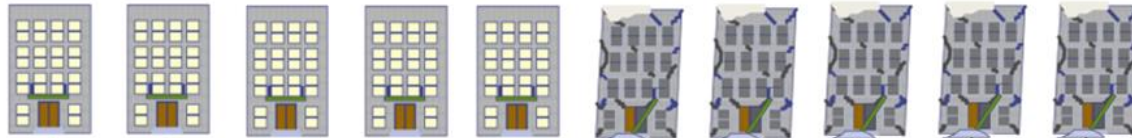
OutputIdx: Output Index

Infrastructure Index

DAY 0: *Infraldx* = 10%



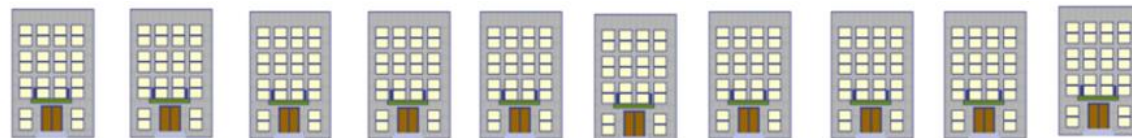
DAY 2: *Infraldx* = 50%



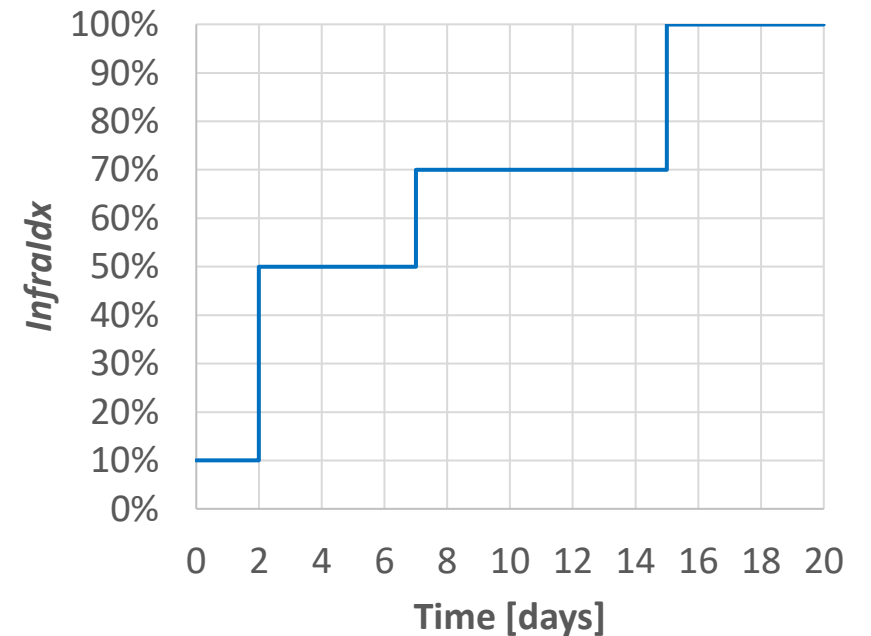
DAY 7: *Infraldx* = 70%



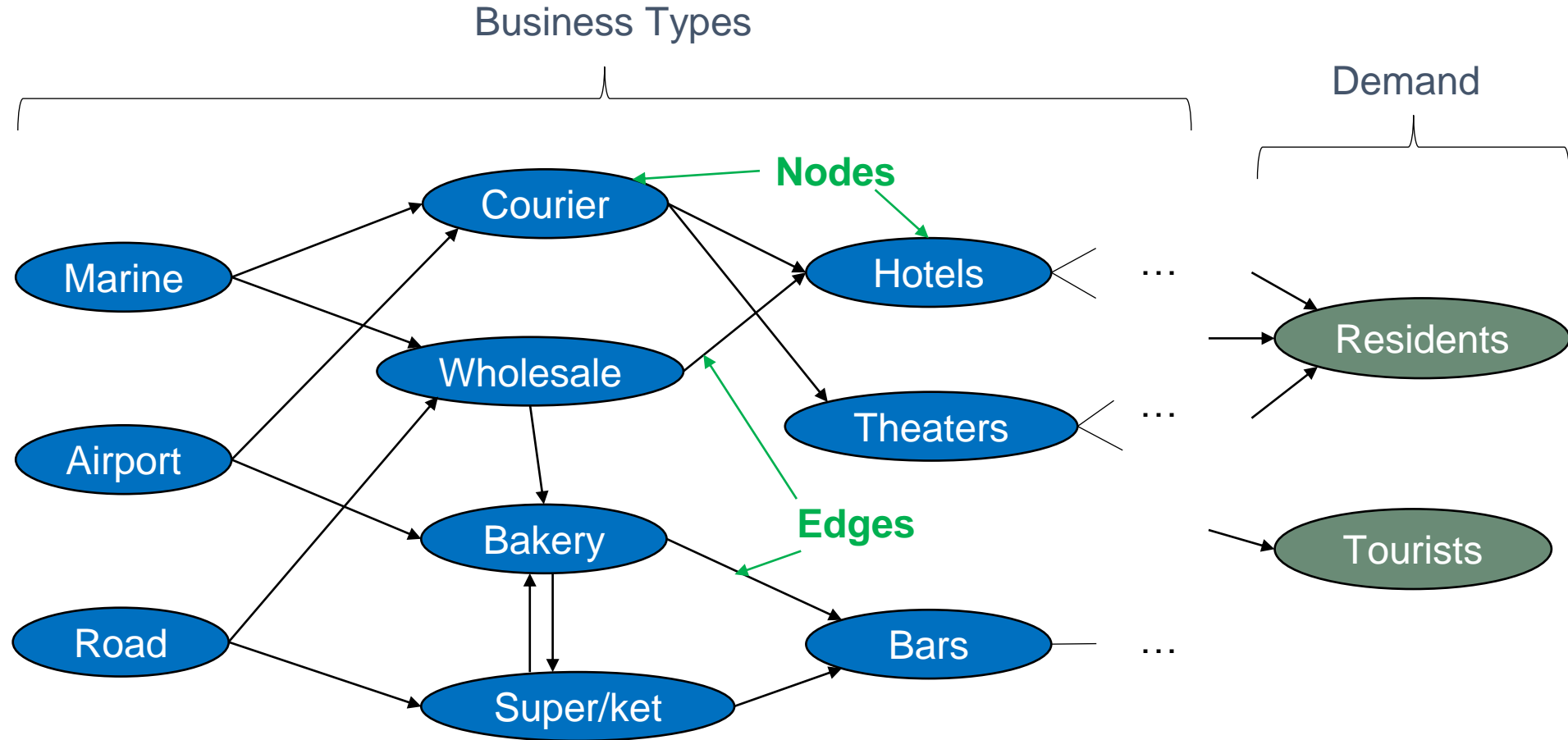
DAY 15: *Infraldx* = 100%



Downtime diagram



Input Index



Input Index (Retail trade)

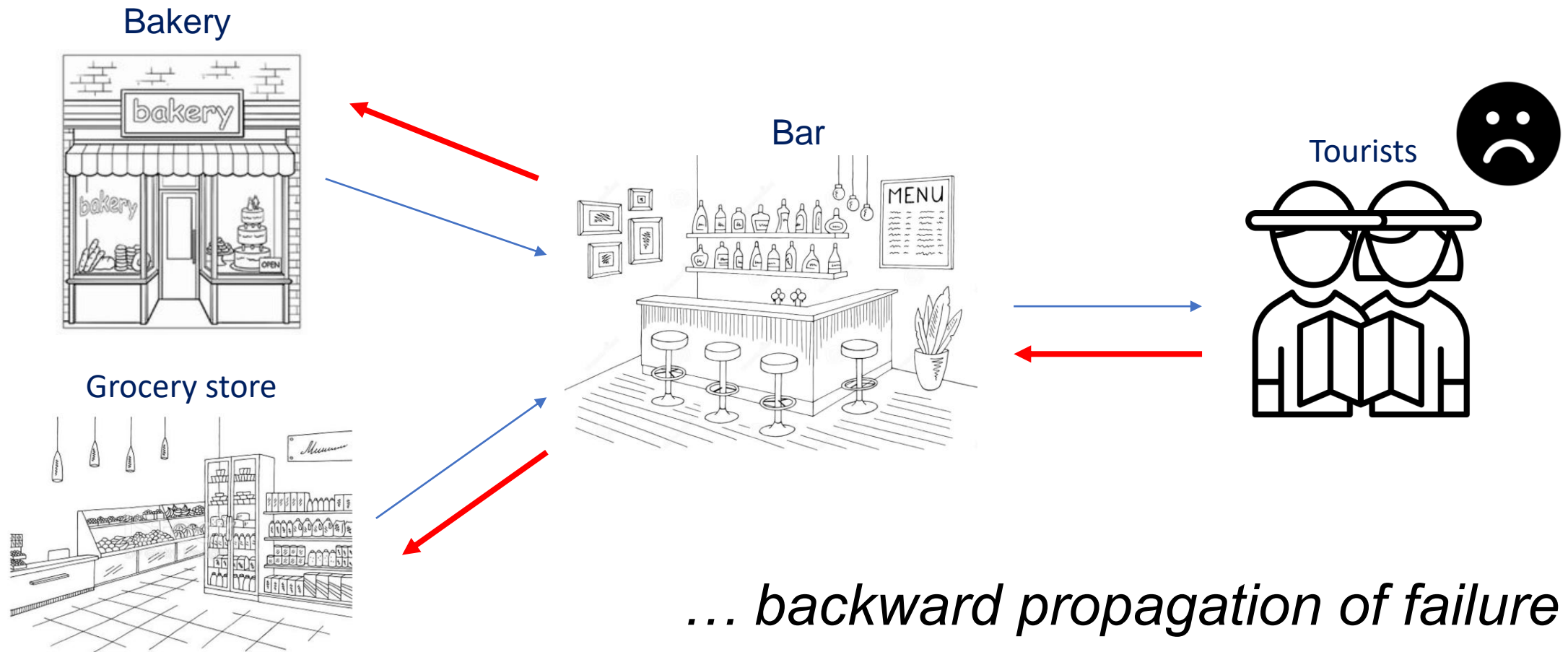
time →

Retail trade	0h	1h	2h	4h	8h	12h	1d	2d	4d	1w	2w	1mo	2mo	∞
Retail trade	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Business, scientific and technical activities	1	1	1	1	1	1	1	2	2	3	4	5	5	5
Financial services and insurance activities	1	1	1	1	1	1	1	2	2	3	3	3	4	5
Wholesale trade	1	1	1	1	1	1	1	2	3	4	5	5	5	5
Manufacturing	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Agriculture, forestry, fishing	1	1	1	1	1	1	1	1	1	1	2	2	2	2
Real estate activities	1	1	1	1	1	1	1	1	1	1	1	1	2	2
Trade and repair of motor vehicles	1	1	1	1	1	1	1	1	1	1	2	2	2	3
Construction	1	1	1	1	1	1	1	1	1	1	1	2	2	2
Accommodation	1	1	1	1	1	1	1	1	1	1	2	2	3	3
Food and beverage services	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Education	1	1	1	1	1	1	1	1	1	1	1	1	1	1

business sector ↓

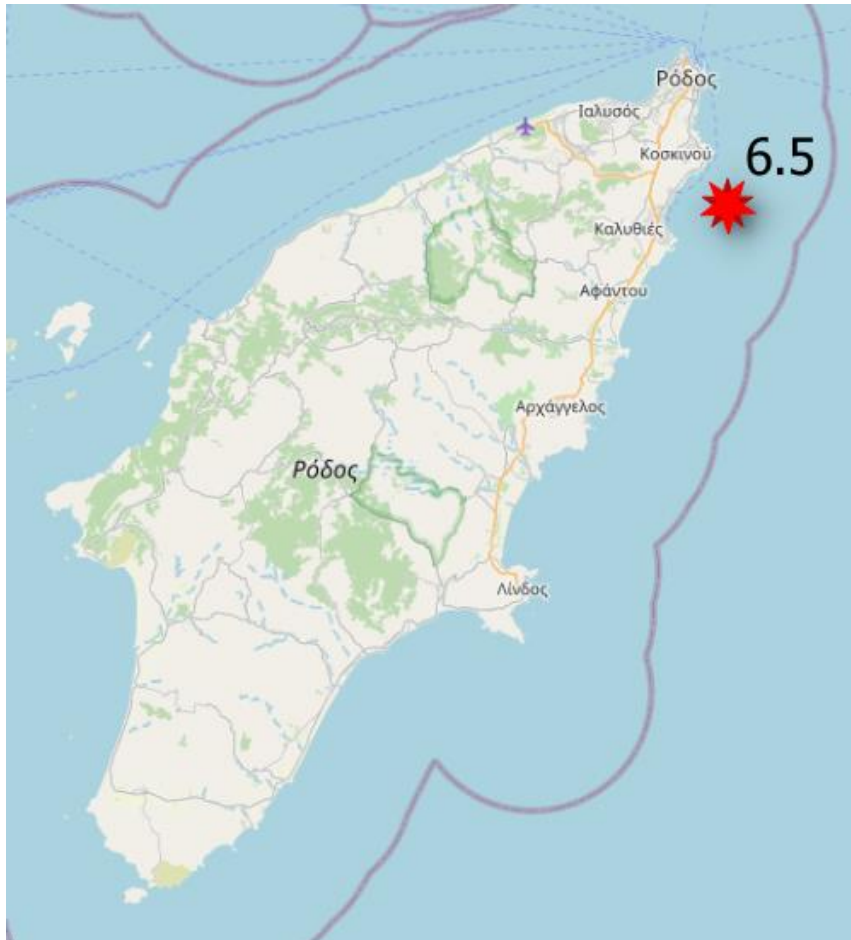
1: 0% loss of functionality
 3: 50% loss of functionality
 5: 100% loss of functionality

Output Index

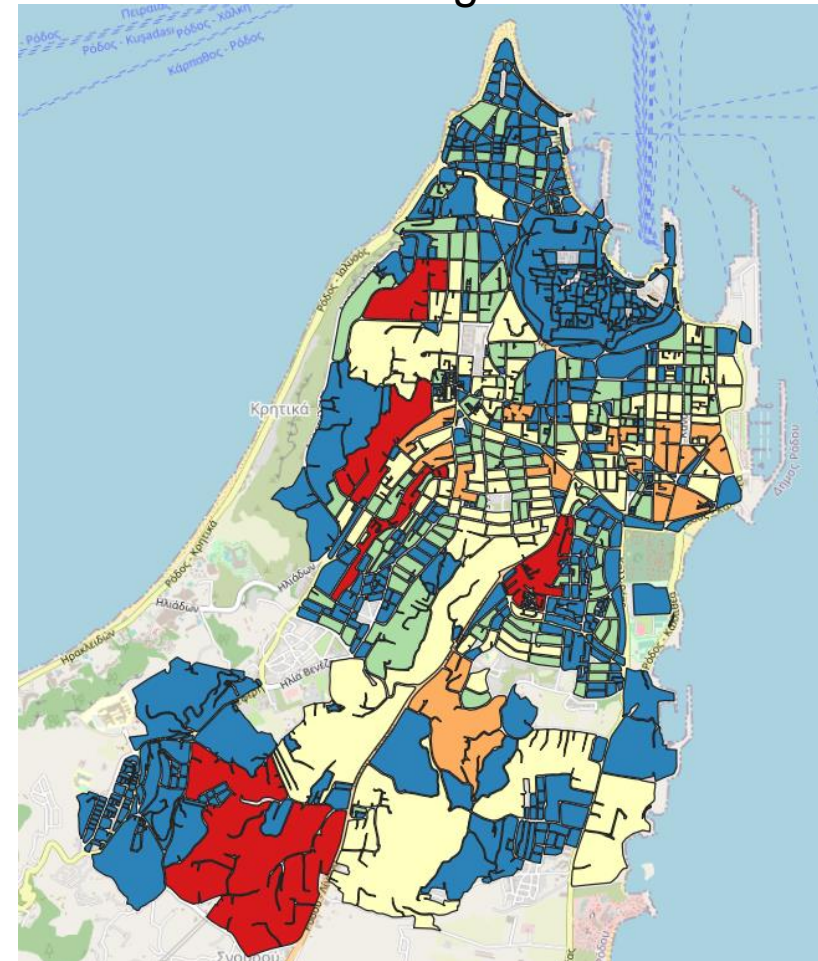


Seismic event to Rhodes

Magnitude 6.5 near the historic city



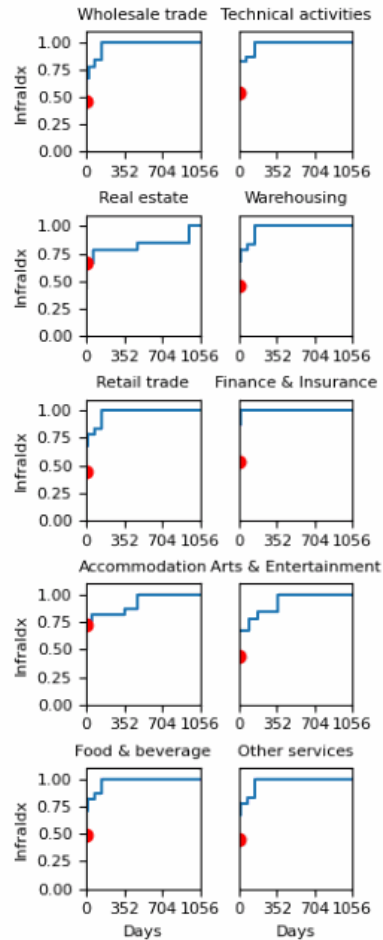
Damages to residential and commercial buildings



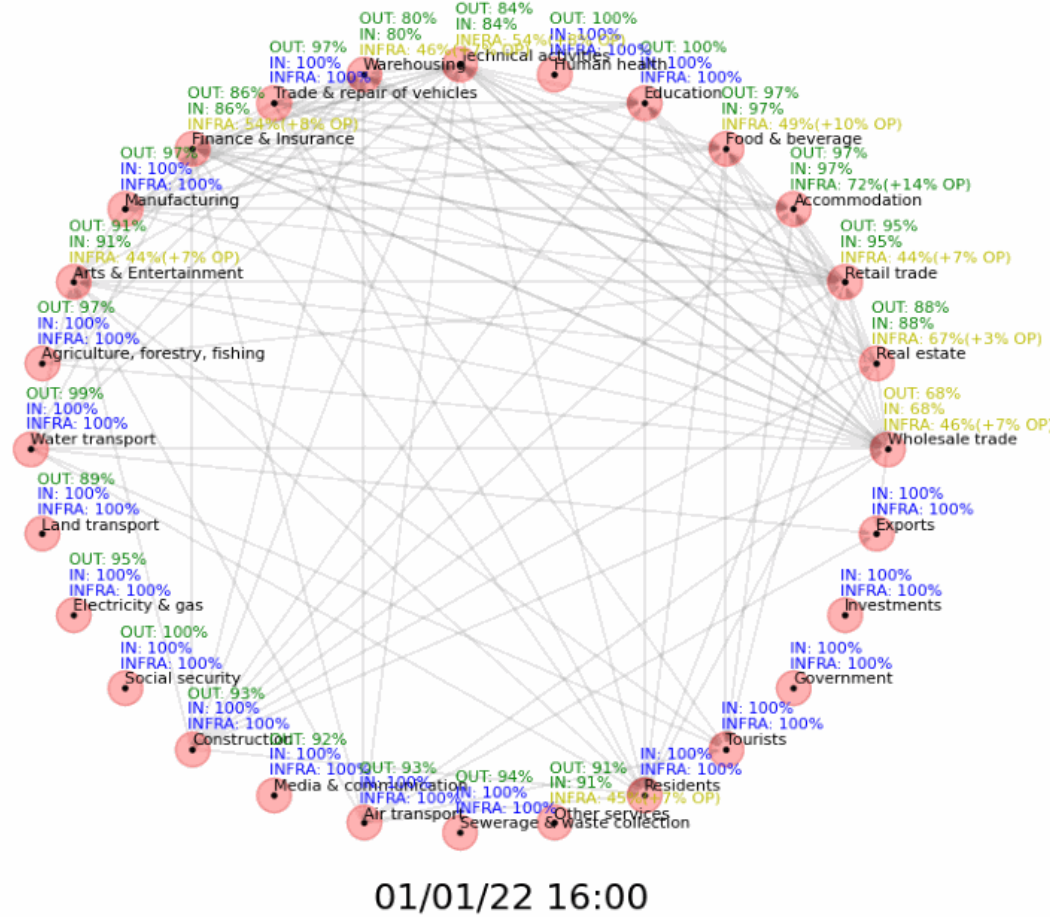
Examples of application

Seismic event to Rhodes

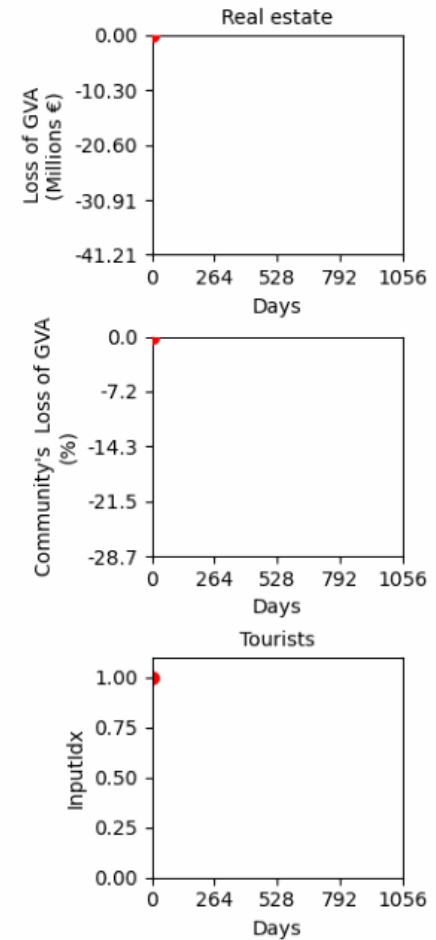
Downtime Diagrams



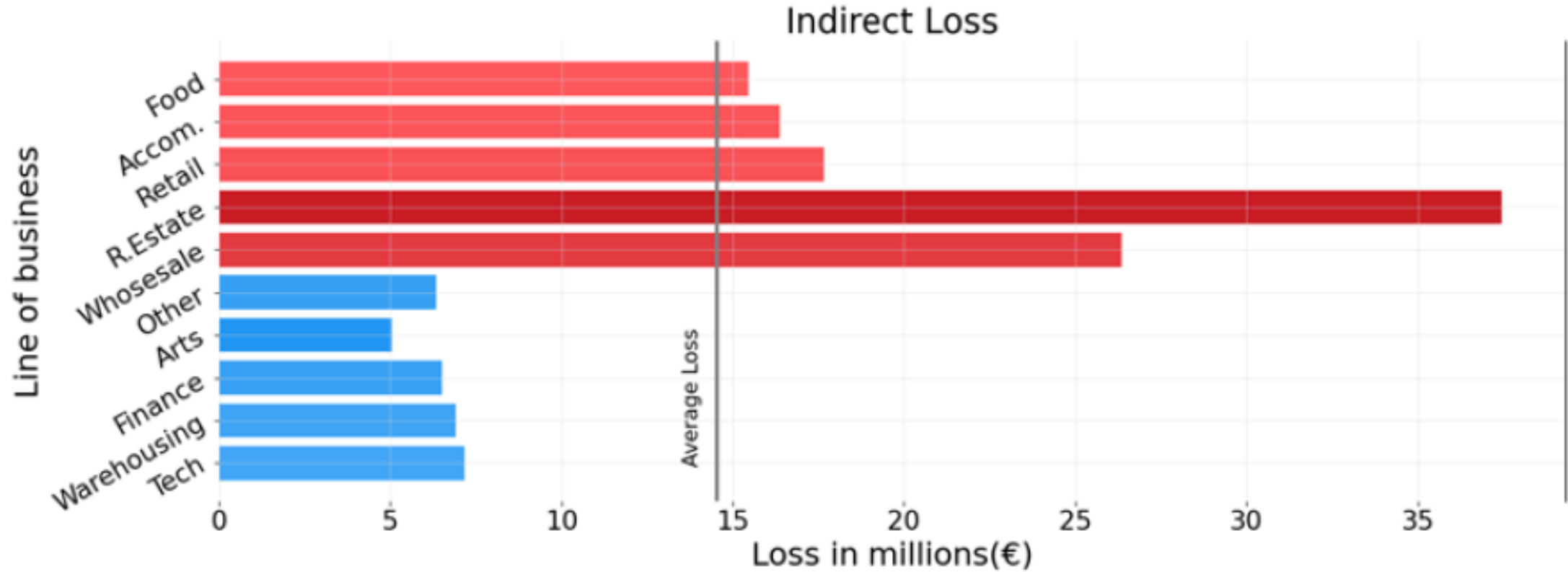
Socioeconomic Model



Impact Analysis Results



Seismic event to Rhodes



Total Direct Losses: **825 mill. €**

Total Indirect Losses: **163 mill. €**

Thank you for your attention

Special thanks to teams of NTUA
and RED!!

