

What exactly is resilience?

Exploring the concept and its meanings for Agent Based Modeling

SPM 9555 Guest lecture, Room D

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Today's lecture: resilience

- What does it mean?
- Why necessary in (networked) organizations?
- Some examples of resilient organizations
- How to model and measure resilience with ABM's?

What exactly is 'resilience'?

MSN Dictionary:

- 1. speedy recovery from problems:** the ability to recover quickly from setbacks
- 2. elasticity:** the ability of matter to spring back quickly into shape after being bent, stretched, or deformed

Latin: 'risilio' to jump back

Physics, engineering:

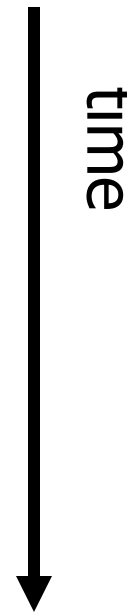
“the ability of a material to return to its former shape after a deformation”

What exactly is 'resilience'?

Relevant scientific research (in social sciences) about resilience?

A short history of the meaning and use of resilience in:

- Psychology
- Ecology
- Organization theory/management sciences



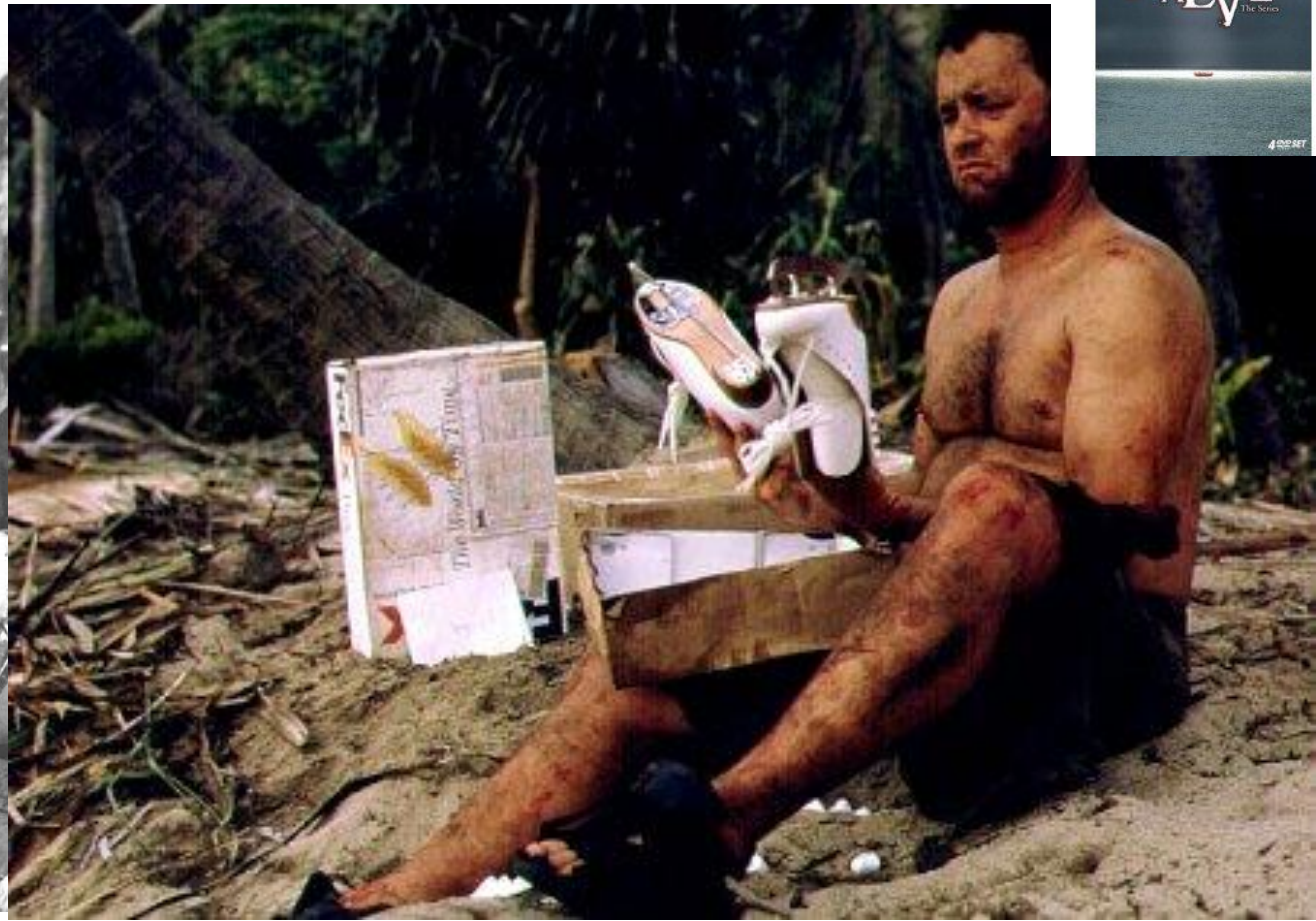
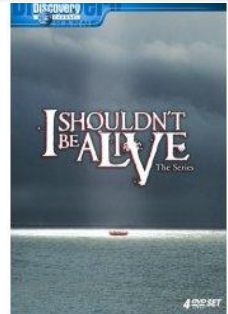
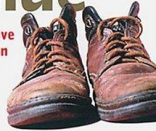
Classical examples of resilience

Individual psychology: sturdiness, resourcefulness in the face of challenges

Collins gem

SAS Survival Guide

How to survive in the wild, in any climate, on land or at sea



Resilience in psychology

- concept developed in the 1950s
 - mental disorders (schizophrenia, depression, anxiety disorders)
 - children from “high-risk parents”
- Adversity or trauma:
cancer
drugs abuse
abusive parents
psychosomatic parents
unemployed parents
community violence

“Positive adaptation despite adverse experiences of significant adversity or trauma” (Luthar & Cicchetti, 2000:58)

Resilience in psychology

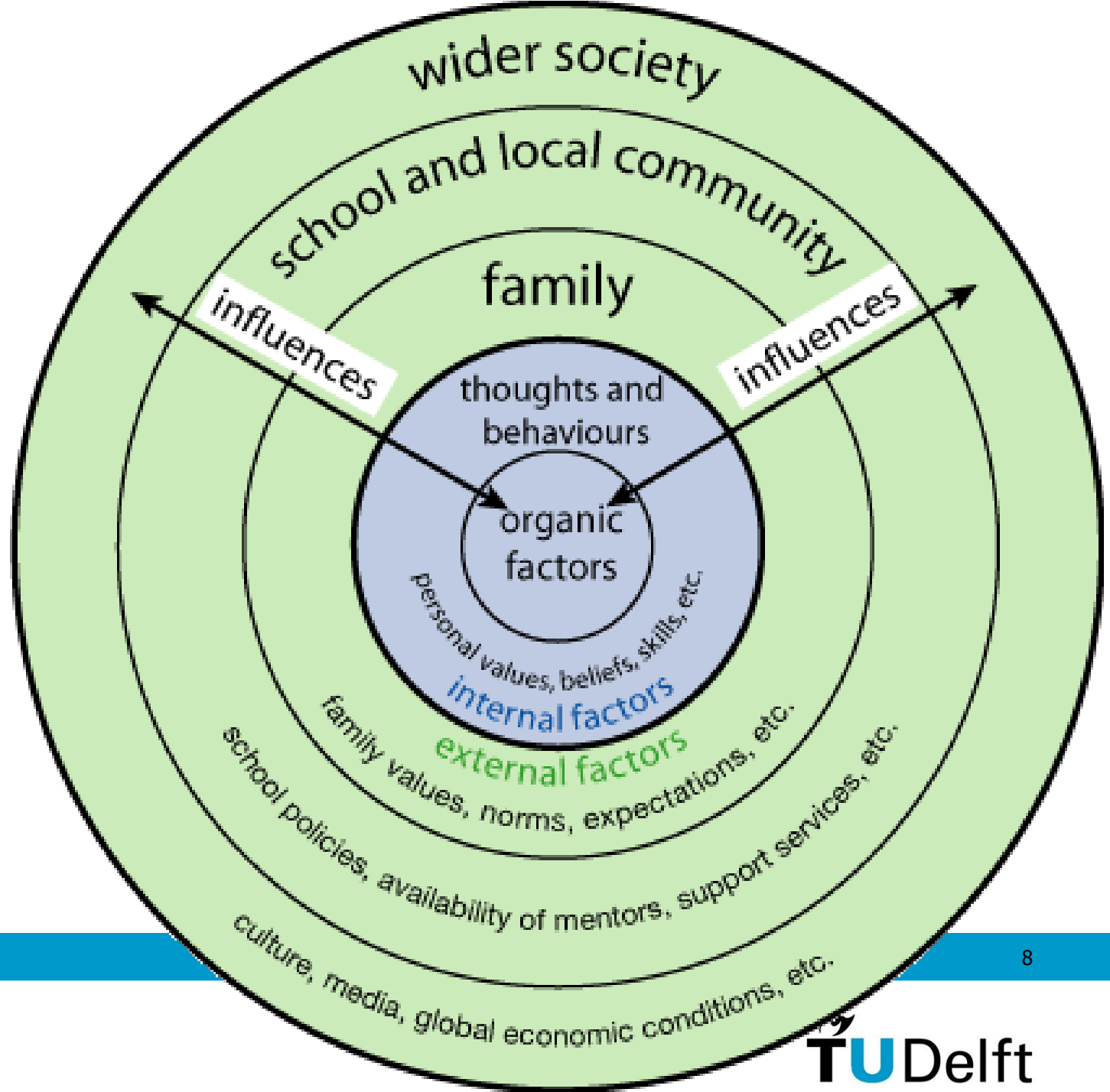
personality trait

- 'you have it or you don't'
- American dream
- 'Resiliency'
- individual competence
(= output)

***process* characteristic**

- individual competence and...
- interaction with environment





Resilience in ecology

- until the 1970s: stability & equilibrium
- complex, dynamic systems cannot be managed or 'predicted' with linear models
- focus on instability and dynamics in ecosystems

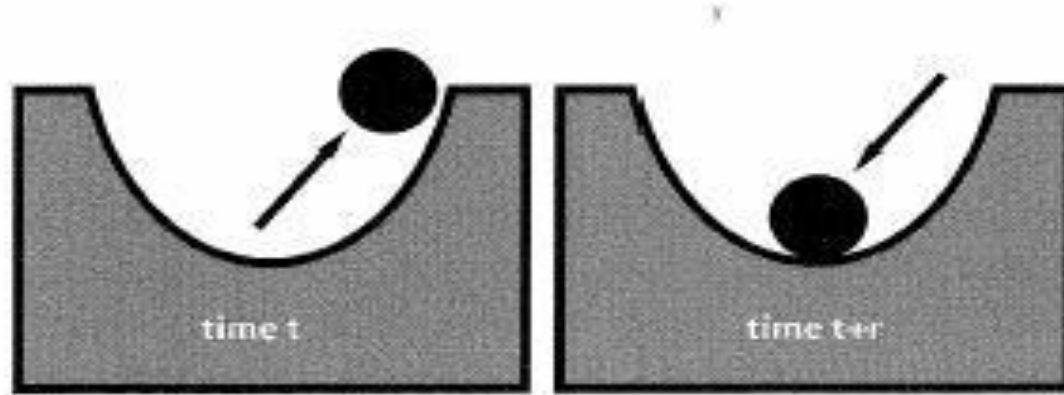
- 1973: C.S. ('Buzz') Holling
- Resilience: "*The ability of a system to absorb disturbance and still retain its basic function and structure*" (Walker & Salt, 2006:1)
- Two dimensions of resilience



Ecology

the capacity of something to bounce back to a 'normal' condition following some shock or disturbance

A. Engineering resilience (r).



Ecology resilience

Resilience concepts	Characteristics	Focus on	Context
Engineering resilience	Return time, <i>efficiency</i> of function	(speed of) recovery, stability	Vicinity of stable equilibrium
Ecological resilience	Buffer capacity, ability to withstand shock, <i>existence</i> of function	fluctuation, persistence, robustness	Multiple equilibria, stability landscapes
Social-ecological resilience	Interplay disturbance and reorganization, sustaining and developing	Adaptive capacity, transformability, learning, innovation	Integrated system feedback, cross-scale dynamic interactions

Measuring resilience

- The key question is how to measure resilience in socio-technical systems?
- Output characteristic
- Hindsight bias
- Process characteristic
- So what processes show resilience at work?

Resilience in organization theory/ management sciences

- Why do some companies survive while others fail?
- Resilience: "*The capability of individuals, groups, or organizations to adapt quickly to changes*" (Cho et al., 2006:25)
- Because of different 'background', different emphasis on sources of organizational resilience, and different resilience strategies

Resilience in organization theory/ management sciences

How can organizations be resilient?

- Fragmented field, scarcely researched
- 2 'schools': ecology and psychology

Why is resilience important for advanced management in organizations?

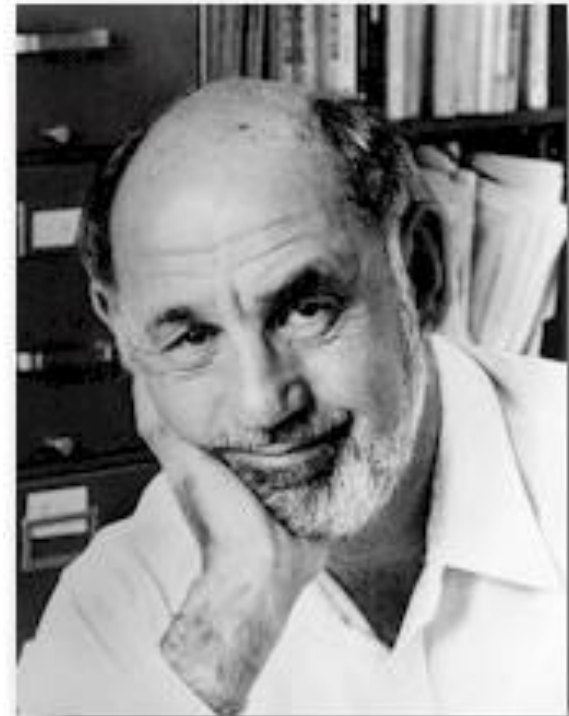
- Today's organizational environment – networks of organizations – managers are confronted with:
 - Globalization
 - (hyper)competition
 - Technological dynamics
 - Long supply chains/(in)direct interdependencies
 - Unexpected and unforeseen events
 - Unidentified risks

How organizations deal with risks?

- Aaron Wildavsky (1930-1993)

Anticipation

• **1. expectant waiting:** the feeling of looking forward, usually excitedly or eagerly, to something that is going to happen



(Organizational) tools of anticipation:

Sinking organizational resources into specific defenses against particular risks

- Risk in analysis Probabilistic risk analysis
- Risk in design Redundancy/overdimensioning
- Risk in operations Planning & detailed procedures
- Risk in time Risk evaluation

surprises, risks and dynamics have increased dramatically and become unmanageable through anticipation (Weick & Sutcliffe, 2001)

Assumptions for successful anticipation

Risk is assumed to be:

- constant
- certain
- predictable/ foreseeable
- all potential (risky) system conditions identified
- all potential (risky) system conditions fully specified

For anticipation to succeed....

Minimum requirements

- Near incomplete information (on risk and system)
- Complete understanding of causal relationships
- Adequate resources to mitigate risks (enough, the right answer to the right problem)
- Complete control of all resources that mitigate risk

Consequently....

- There is no such thing as failure-free performance!
- Failure is normal, (especially in) a networked environment
- All organizations are affected by failure (deviation from expected and desired results) at some point or another
- Three types of unexpectedness
 - 1.An event that was expected to happen does not occur
 - 2.An event that was not expected to happen does happen
 - 3.An event that was unthought-of happens

resilience: *"the capacity to cope with unanticipated dangers after they have become manifest, learning to bounce back"*
(Wildavsky, 1991:77)

(i.e. ecological resilience)

	Small amount of knowledge about what to do	Large amount of knowledge about what to do
predictability of change: high		
predictability of change: low		

Yet some organizations seem to defy failure

- Organizations that do not fail catastrophically
They suffer setbacks, crises, surprises, natural disasters, like all other organizations but....
- This never results in catastrophic failure for the organization
- Scientific proven concept? Hindsight bias
- organizational theory has studied organizations that operate reliably: High-Reliability Organizations
- organizations that have no choice but to function reliably



Nuclear aircraft carriers





Air Traffic Control

Nuclear power plants



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High Reliability Organizations? Examples from a specific breed

The organizations are not reliable because of their technology!

- Advanced, yet robust, technology

The organizations are not reliable because of their organizational structure

- Intelligent structures, but not unique

The organizations are not reliable because of their procedures

Resilience in a networked environment

- Effective HRO's are anticipatory *and* resilient
- HRO's were relatively more anticipatory than resilient
- In networked environment still anticipatory *and* resilient
- but, in a networked environment, reliability is achieved with a *relative larger emphasis* on resilience than anticipation as a result of increased uncertainty, volatility and surprises

Mechanisms that contribute to resilience

- Redundancy or slack
- Culture of reliability
- Mindfulness
- improvisation

Characteristics of culture of reliability

- flexible decision-making processes and authority structures
- continuous search for improvement/ training for worst cases
- Continuous communications among informed employees
 - Highly experienced top level management
 - Intense training of personnel
- Distributed power
- Passion for the work (mindfulness)
- Conditioning for disruption

Mindfulness/mindlessness

- decision makers seek evidence to confirm expectations and avoid evidence that disconfirms them
- tendency to overestimate validity of currently held expectations
- continuing search for confirming evidence postpones realization that something unexpected is developing
- a rich awareness of detail and an enhanced ability to discover and correct errors that could escalate into a crisis

	Encourage growth	Promote competence	Restore Efficacy
Individual			
Group			
Organization			

Applying knowledge to Agent Based Modeling

- Can (aspects) of (socio-technical) resilience be modelled in ABMs?
- Which ones?
- What about the mechanisms?
- What complicates the modeling of resilience?