Complex tourism digital ecosystems

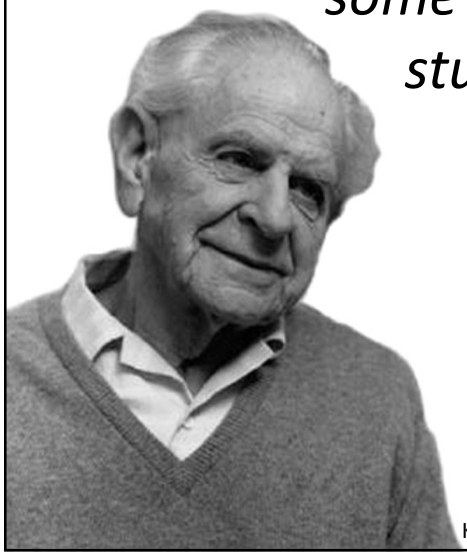
Rodolfo Baggio

Master in Economics and Tourism
Dondena Centre for Research on Social Dynamics and Public Policy
Bocconi University, Milan, Italy

Tomsk Polytechnic University, Tomsk, Russia

rodolfo.baggio@unibocconi.it

Trento, 5-9 July 2019



We are not students of some subject matter, but students of problems. And problems may cut right across the borders of any subject matter or discipline.

Karl Popper

Annals of Tourism Research 46 (2014) 16–28

Contents lists available at ScienceDirect

Annals of Tourism Research

journal homepage: www.elsevier.com/locate/atoures

Academic myths of tourism

Bob McKercher [a,*], Bruce Prideaux [b]

[a] The Hong Kong Polytechnic University, Hong Kong Special Administrative Region, China
[b] James Cook University, Australia

ARTICLE INFO

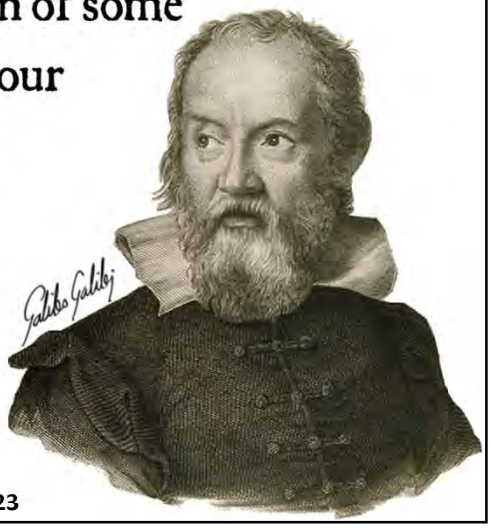
Article history:
Received 25 February 2013
Revised 16 January 2014
Accepted 3 February 2014

Keywords:
Myth
Discipline
Field of study

ABSTRACT

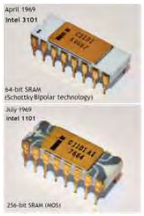
Myths play a critical role in the development of any field of study. They act as the central point for coalition, and differentiate disciplines from each other. The absolute truthfulness of some myths, therefore is less important than their symbolic truth. Other myths, though, can be damaging, promulgating falsehoods and inhibiting the development of a field. This paper examines the roles myths have played in establishing the cult of tourism scholarship. Senior academics were surveyed to identify what they believe to be myths about tourism. Six broad categories of myth emerged: self interest; foundation; reactive stakeholder; convergent; too good not to be true; and myths inherited from other disciplines. Promulgation of these myths has been abetted by methodological inertia.

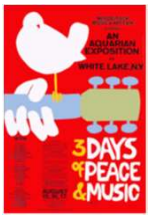
In Sarsi I seem to discern the firm belief that in philosophizing one must support oneself upon the opinion of some celebrated author, as if our minds ought to remain completely sterile and barren unless wedded to the reasoning of some other person.

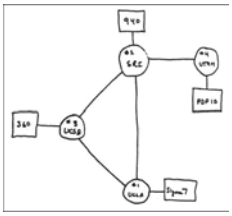


The Assayer, 1623

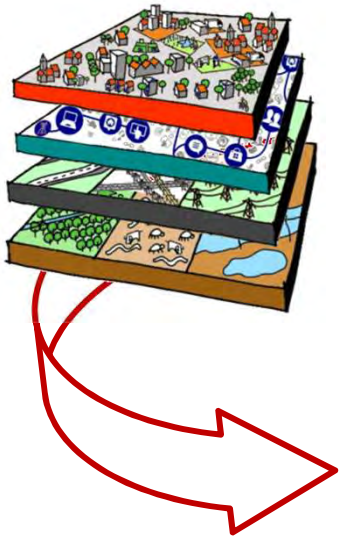
the global village







Internet & the Web are not only a technological manifestation, but the representation of social structures & processes

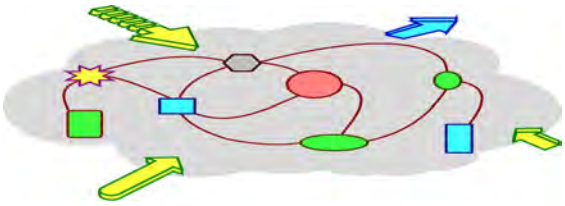


Digital ecosystem:
the digital, ecological & socio-economic assets that interconnect & interact

anatomy & physiology

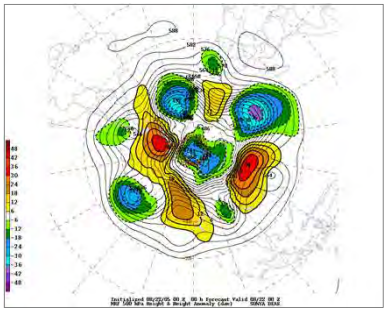
System

- Entity (conceptual or real) made of a number (normally not small) of elements interacting dynamically & generating some global behavior
  - in a system "the whole is more than the sum of its components"



How do we look at systems?

9



complex systems :

[many] elements

nonlinear relationships

emergent properties

self-organizing

no "master-mind"

no blueprint

evolving

adaptive (*learning*)

resilient

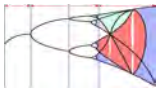
11

Systems

- Simple
  - few components, linear and predictable interactions, repeatable, decomposable, knowable

- Complicated
  - many components, cause and effect separated over time & space but repeatable, decomposable, analyzable

- Complex
  - nonlinear interactions, sensitivity to initial conditions, dynamic, adaptable to environment, produce emergent structures & behaviors, can become chaotic
    - non decomposable, non predictable, non tractable analytically

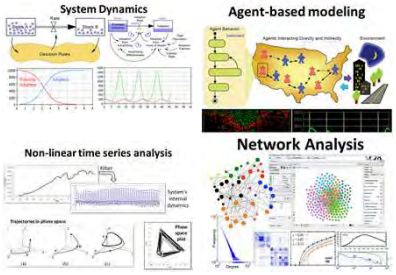


… a single system can go through different states & can look differently depending on scale of observation

12

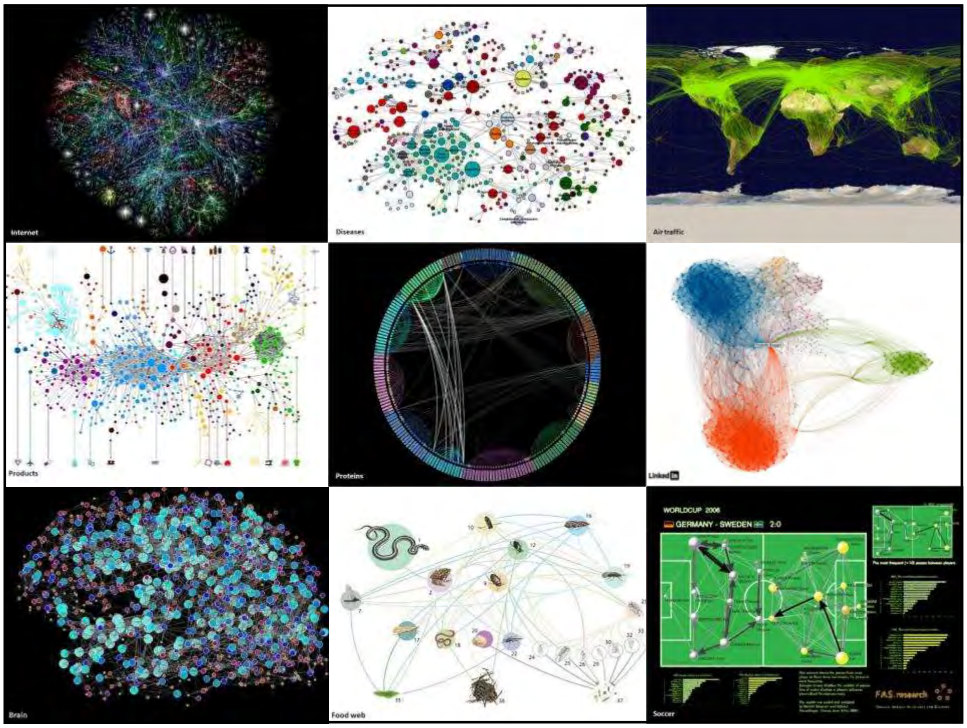
The “system approach” toolbox

- A wide range of possible tools & techniques
  - based on modeling and numerical simulations
  - most quite *old*, dated back to XVIII-XIX century, but “usable” only with recent computer technology
- Toolbox
  - System dynamics
  - Agent-based modeling
  - Nonlinear dynamics (chaos & complexity theory)
  - *Network science* (✓)

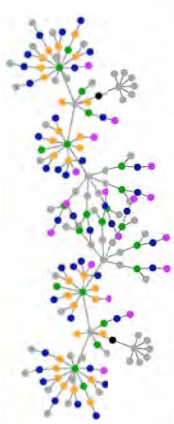


13

why networks?



Network science: a list of topics



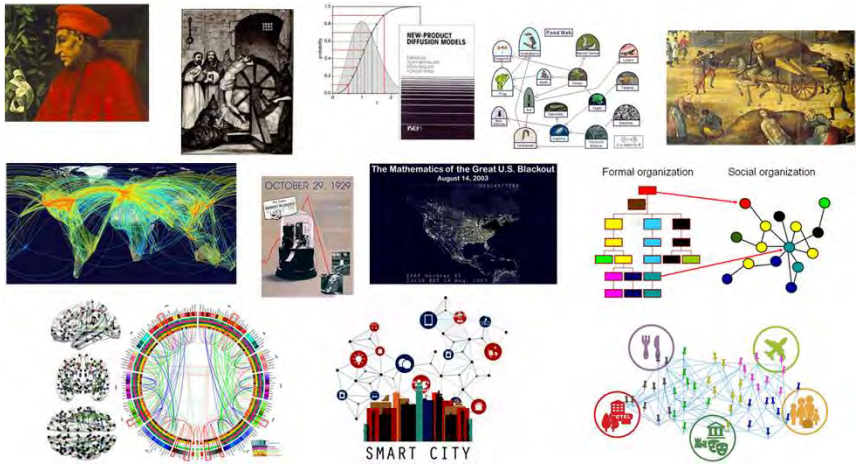
Archeological routes
Art trends
Brain functions & diseases
Browsing and foraging
Cellular network design & monitoring
Cloud monitoring
Cognitive Networks
Collaborative filtering
Competition & cooperation
Computer networking
Content popularity
Content creation
Creativity & innovation
Cultural networks
Cybersecurity
Data exploration and visualization
Data mining
Design of robust and efficient infrastructures (power, water etc.)
Design of transport networks
Detect trusted/influential users
Detection of community and social changes

Early identification of financial crises
Economic relationships
Ecosystems
Epidemiology & immunization strategies
Estimation methods, sampling, random walks
Financial transactions
Food webs
Fraud & anomaly detection (espionage, sabotage etc.)
Friendship
Genomics
Identities and reputations
Images and video semantic analysis
Immigration flows
Industrial networks
Information graphs in social media
Innovation diffusion
Knowledge formation, diffusion & management
Language & texts analysis
Latent semantic filtering
Memes evolution
Modular and hierarchical structures

Node ranking
Node selection & reachability
Opinion formation
Personalized Search
Propagation of information & cascading properties
Recommendation networks
Robustness in crises and sabotage
Routing
Scientific collaborations
Self-organization
Sharing mechanisms
Social filtering
Social groups formation and evolution
Social media monitoring
Software structures
Spam fighting (email & Web)
Supply chain analysis and management
Tourist flows
Trade networks
Traffic Navigation
Trust propagation
Viral marketing
Web crawling (Page Rank)

"...and growing..."

… academic *fun* …



… generate new insights …

17

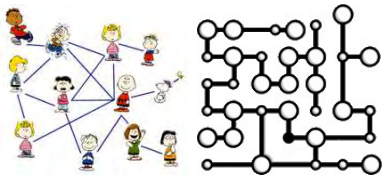
Behind a complex system
there is a network,
that defines the interactions
between the components

We cannot understand
complex systems unless
we map out and understand
the networks behind them

how?

The network approach → modelling

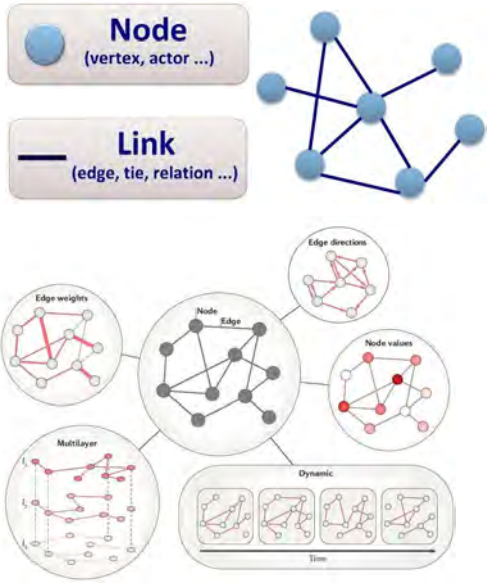
Model:
a concise, workable and predictive representation of the system
(for a specific goal)



study structural properties of networks or ensembles of networks
(even from different environments)
to understand them and assess and their influence on the dynamic behaviors

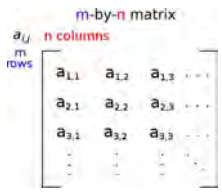
20

Network: an abstraction



	V1	V2	V3	V4	V5	V6
V1	0	0	1	1	1	0
V2	0	0	0	0	1	0
V3	1	0	0	0		
V4	1	0	0	0		
V5	1	1	0	0		
V6	0	0	1	1		

	V1	V2	V3	V4	V5	V6
V1	0	0	W	W	W	0
V2	0	0	0	0	W	0
V3	W	0	0	0	0	W
V4	W	0	0	0	0	W
V5	W	W	0	0	0	W
V6	0	0	W	W	W	0



matrix algebra

Network structural metrics

- ***Macroscopic level*** (system's topological structure)
  - average measures, global metrics (density, diameter, etc.) functional form of distributions
    - Lorenz curve & Gini index of degree distribution
    - (WNG: care to be taken when fitting)
- ***Mesoscopic level*** (system's intermediate structure)
  - modularity (communities), hierarchies…
- ***Microscopic level*** (nodal characteristics)
  - centrality: determine the relative importance of a node within the graph

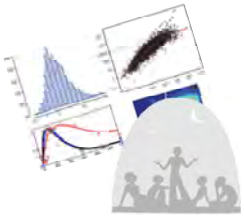
… interpretation needed

22

Qualitative / quantitative (?)

W.E. Deming (1900-1993)

Without data you're just another person with an opinion ↔ **Without an opinion you're just another person with data**

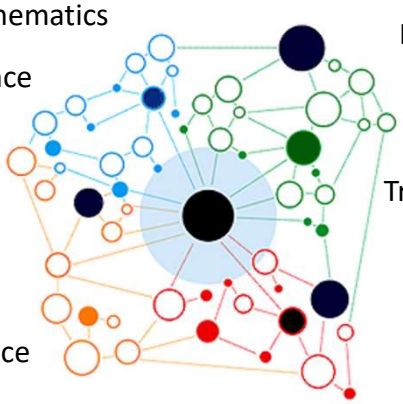


By abolishing the unfortunate categories of qualitative/quantitative and natural sciences/ social sciences that have been set against each other, and letting them join forces for a common goal - to learn about life - people open up for methodological creativity

[Gummesson, 2007]

23

Multi-disciplinarity



Mathematics

Complexity Science

Computer Science

Sociology

Economics

Information Science

Telecommunications

Business & Management

Humanities

Physics

Geography

Transport & Mobility

AI & Machine Learning

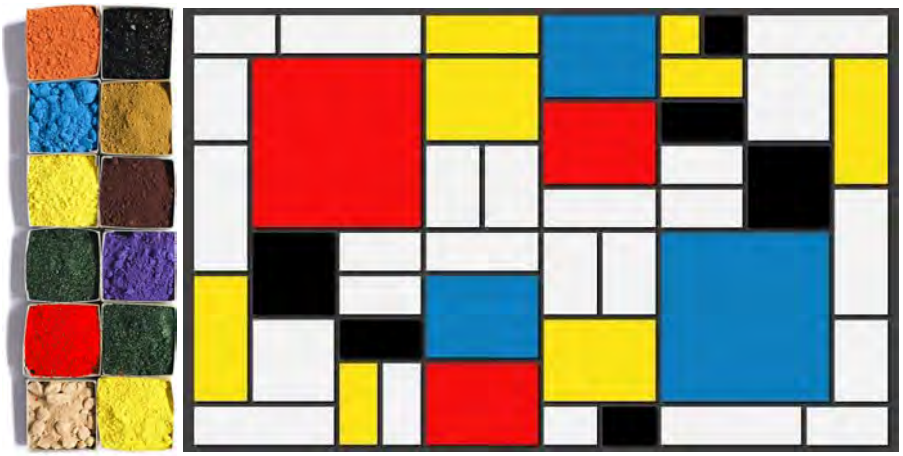
Psychology

Political Science

Tourism, Hospitality etc.

24

Multi-disciplinarity



25

Multi-disciplinarity

…reminder…

PHYSICA A

Grand unification of exotic statistical physics

Dietrich Stauffer*

Institute for Theoretical Physics, Cologne University, Zulpicher str. 77 D-50923 Köln, Germany

Physica A 285 (2000) 121–126

1. Introduction

If you mix Polish piwo with Jack Daniels from the USA, caipirinhas from Brazil, red wine from Bordeaux, red beer from Belgium, and Kölsch from the Prussian Occupied West Bank, your stomach may revolt.

26

Tourism

complex phenomenon

complex systems (tourism destinations)

relationships are crucial

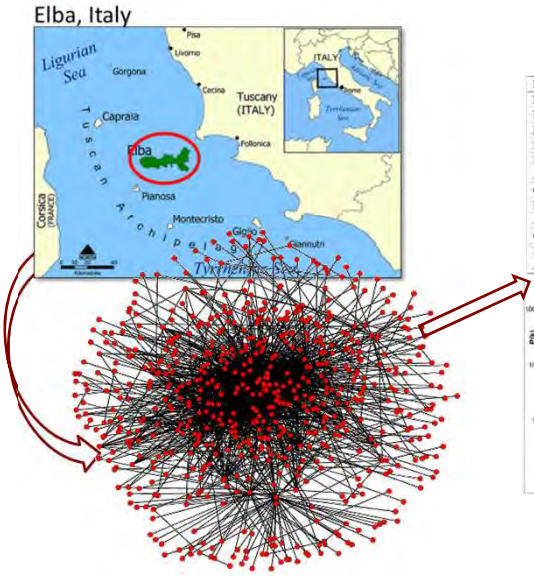
natural environment for network analysis

What have we done?

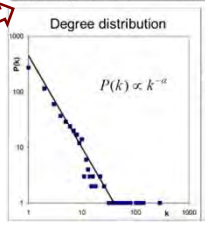
- Examined structural characteristics
  - identify & characterize "important" stakeholders
  - measure extent of and attitudes to collaboration
    - stakeholders, scholars, institutions etc.
  - discover *emergent* communities (beyond traditional distinctions by type/geography etc.)
  - assess ICT usage
- Studied dynamic behaviors & optimization
  - resilience towards external shocks
  - diffusion of information & knowledge
  - effectiveness of advertising & word-of-mouth
  - destination's visibility on WWW
  - evolution models

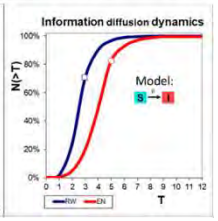
28

A tourism destination



Metric	Elba network	Random	Social networks
No. of nodes	1028	1028	
No. of links	1642	1642	
Density	0.003	0.003	10^{-1} - 10^{-2}
Disconnected nodes	37%	3%	
Diameter	8	13	10
Average path length	3.16	5.86	10
Clustering coefficient	0.050	0.003	10^{-1}
Proximity ratio	34.09	N/A	10^{2} - 10^{3}
Average degree	3.19	3.25	
Global efficiency	0.131	0.169	10^{-1}
Local efficiency	0.062	0.003	10^{-1}
Assortativity coefficient	-0.164±0.022	0.031±0.033	10^{-1} (>0)

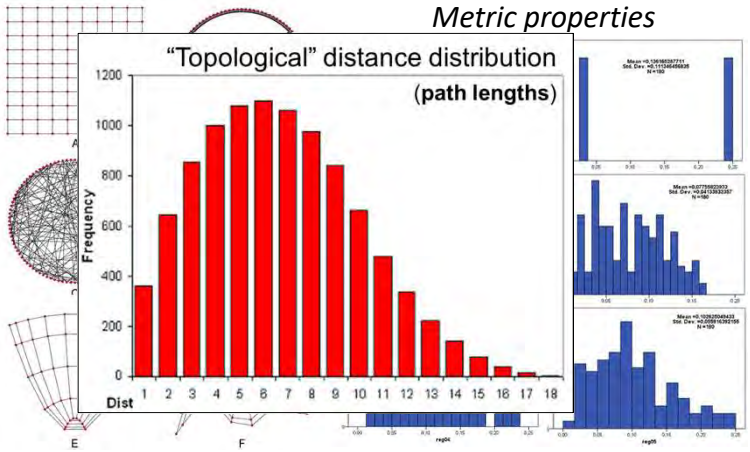




29

Network topology…

Metric properties

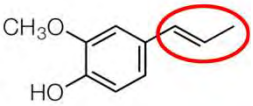


Geometry: where things are; Topology: how things are connected

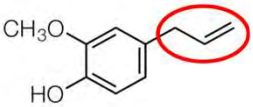
30

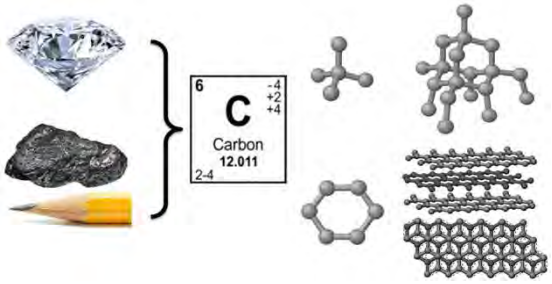
Structure ↔ functions

Isoeugenol: $C_{10}H_{12}O_2$



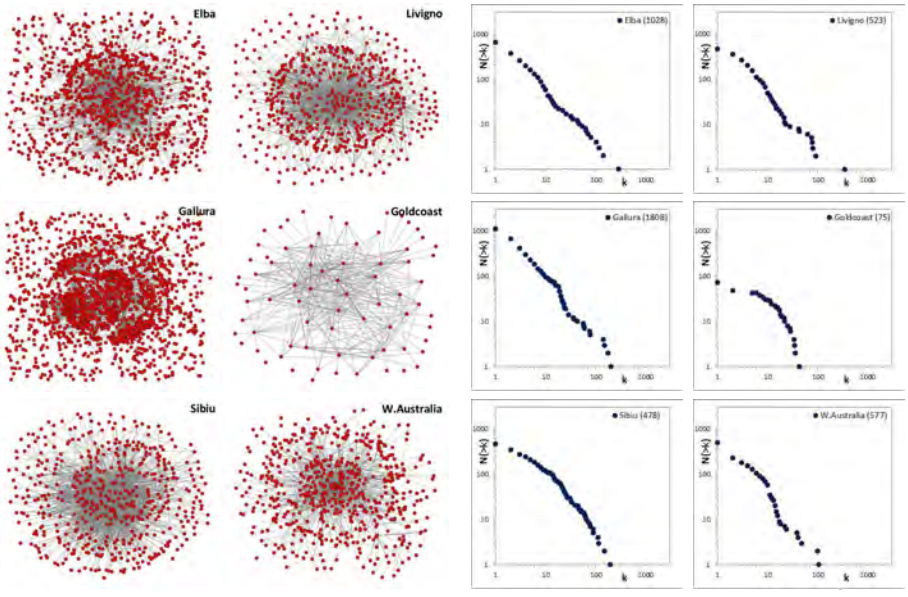
Eugenol: $C_{10}H_{12}O_2$



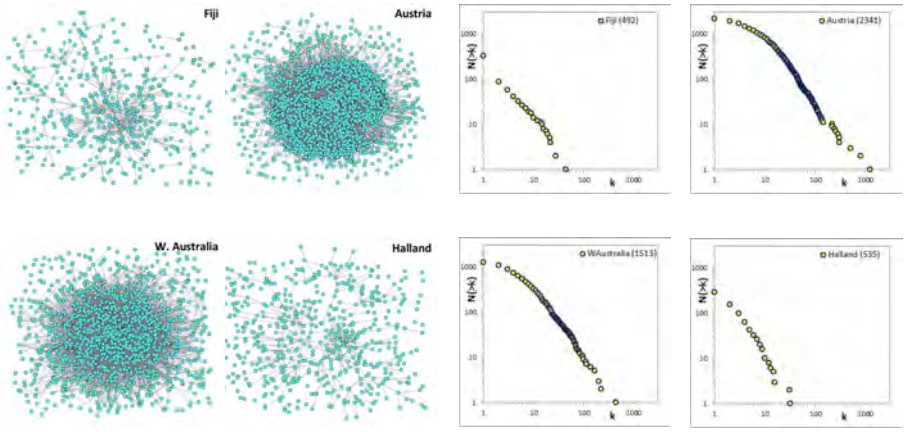


31

Degree distributions (companies)

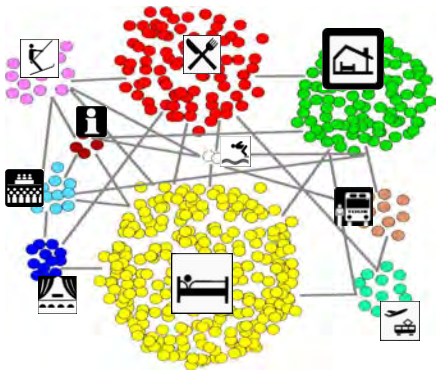


Degree distributions (web)



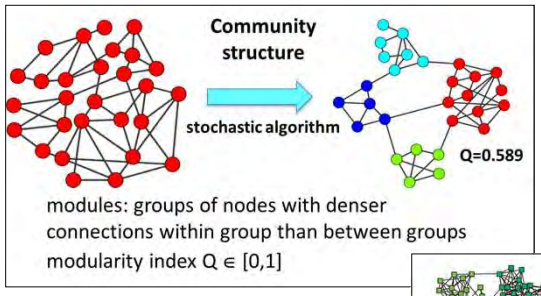
33

Structure of a tourism destination



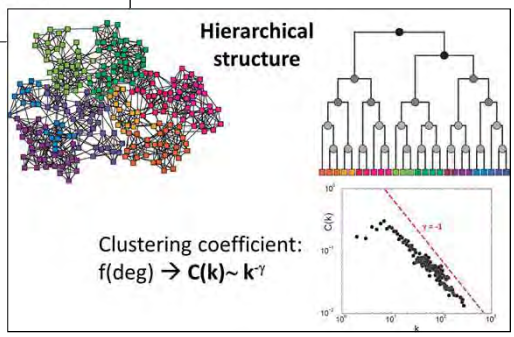
34

Complex network structures



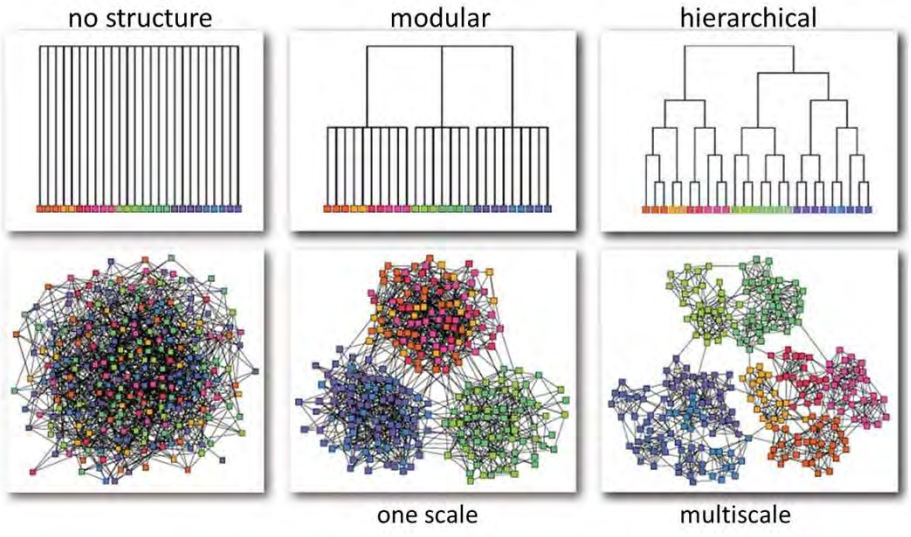
modules: groups of nodes with denser connections within group than between groups

modularity index Q ∈ [0,1]



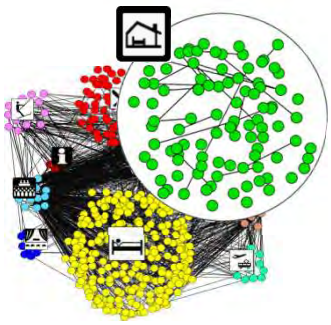
35

Network structures

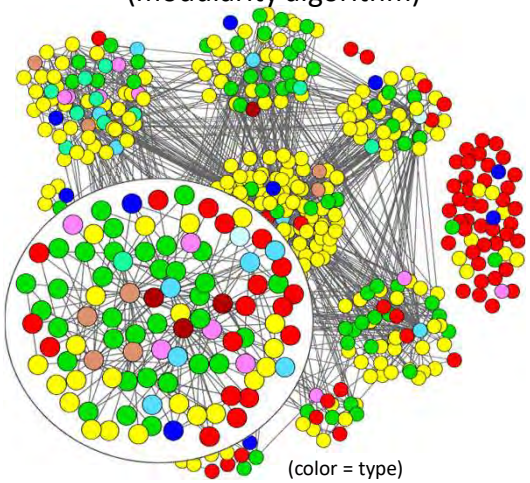


36

Structure of a tourism destination



Community identification
(modularity algorithm)

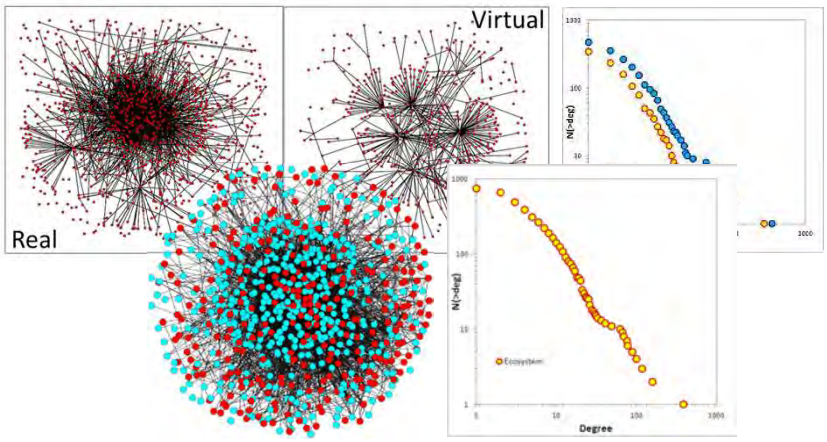


(color = type)

System
SELF-ORGANIZES

37

The digital ecosystem: a network of networks

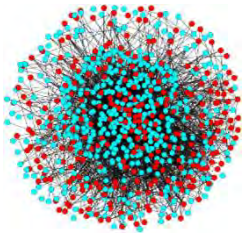


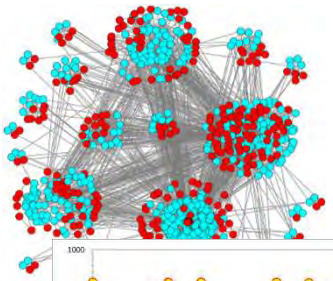
Topological similarity & strong coupling between physical and virtual component

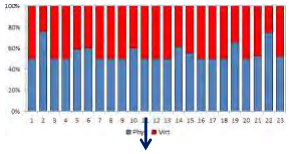
(can be measured: correlation & distribution comparison)

38

The digital ecosystem

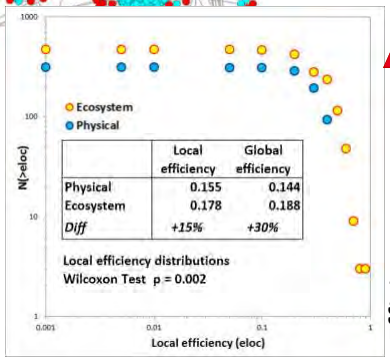






Gini coeff: 0.078

Efficiency (local & global)



	Local efficiency	Global efficiency
Physical	0.155	0.144
Ecosystem	0.178	0.188
Diff	*+15%*	*+30%*

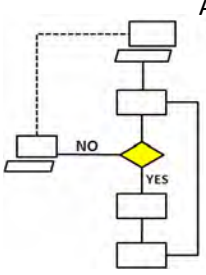
Local efficiency distributions
Wilcoxon Test p = 0.002

Efficiency

39

"Navigating" a destination

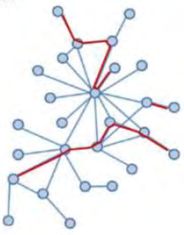
A model:

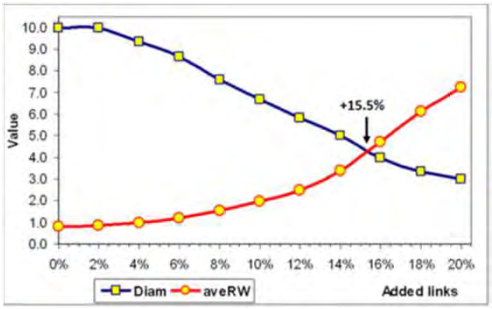


Perform random walks (RW's) and measure ⟨RW⟩

Simulate link growth

Compare all RW measures with graph characteristic dimensions (e.g. diameter "size" of the "walkable" network)

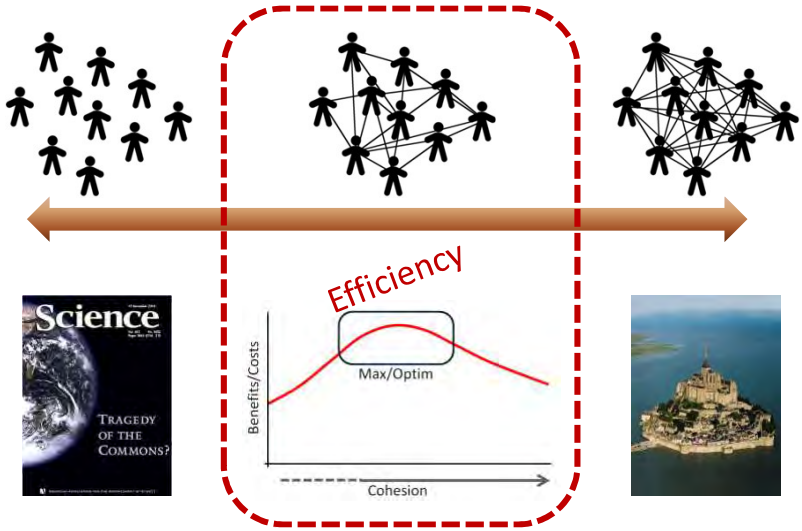




Even a small increase in hyperlinks improves "navigability"

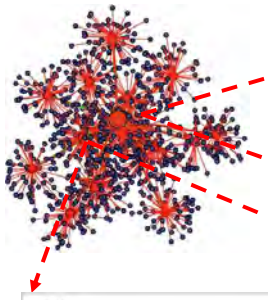
40

Cooperation & collaboration

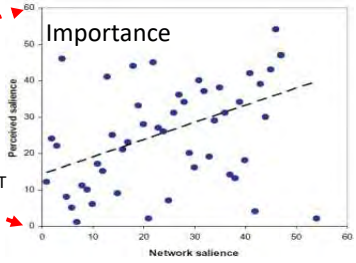


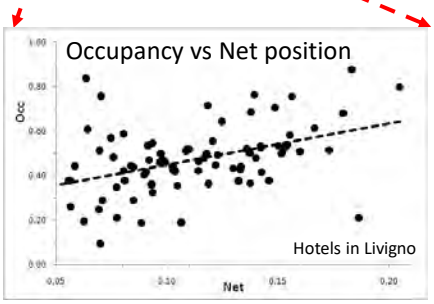
41

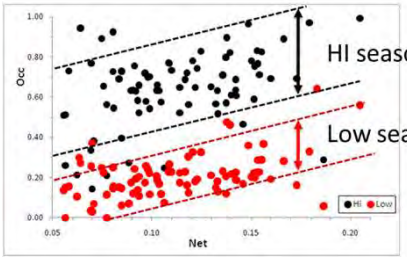
Relationships: positions & roles



AU & IT



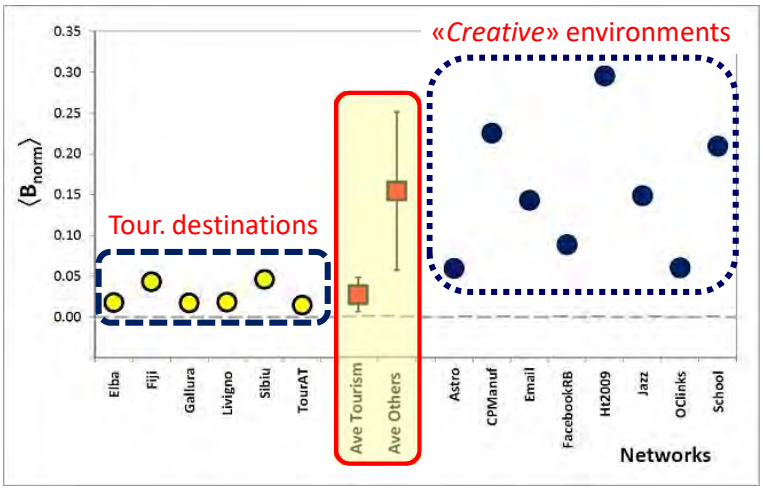




42

Creativity & innovation

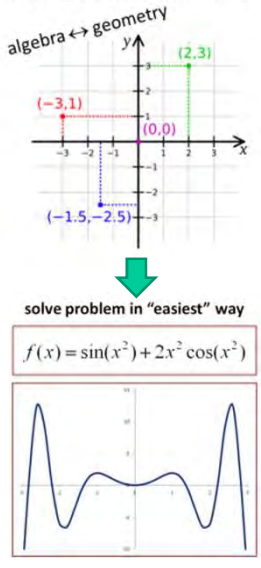
‘‘Simmelian’’ brokerage (B)



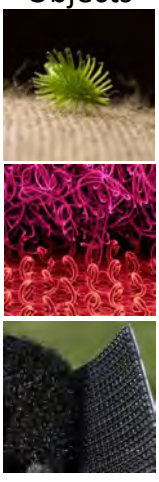
43

Analogy

Mapping between two “worlds”



Objects

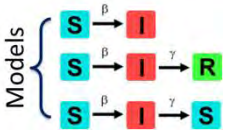


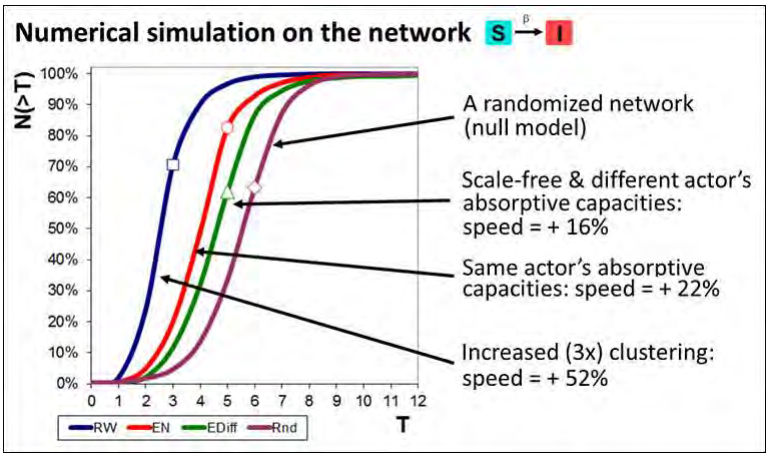
Processes

44

Information diffusion

- Basic epidemiology:
  individuals in a population (N) can be:
  S(usceptible), **I**(nfected), or **R**(emoved)

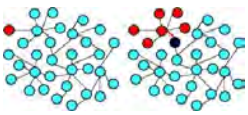




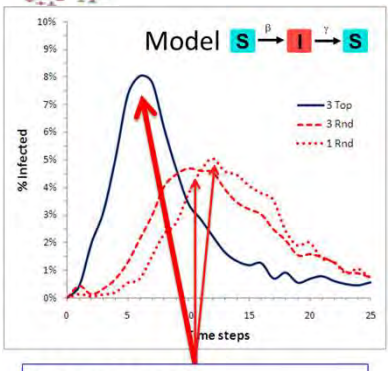
45

Opinion diffusion

- Epidemics don't always happen
- Main parameters:
  - *Reproduction number* $R_0 = \beta/\gamma$
    - no. of new infections caused by a "sick individual"
  - Starting points
    - single/multiple seed
    - individual's "importance"



Start ***infection*** from single, multiple nodes or "top" nodes

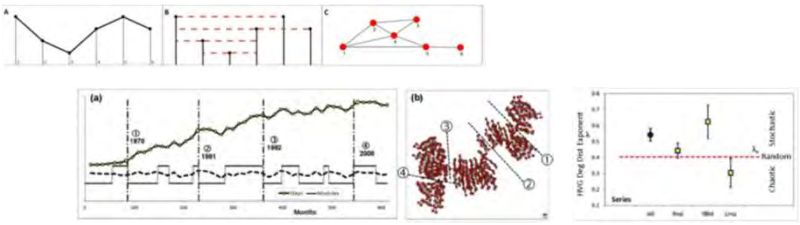


At top spread:
3 Rnd vs. 1 Rnd → +20%
3 Top vs. 3 Rnd → +67%

46

Combining…

Time-series → Network

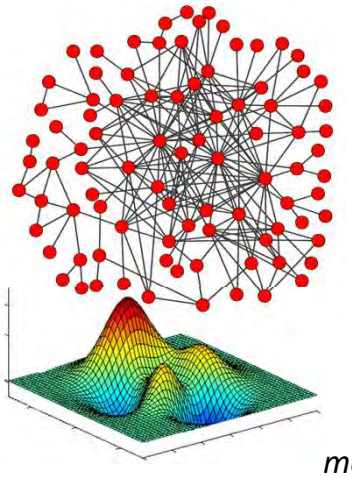


Network → ABM → Network

47

Rewiring, optimizing, etc.…

Rewire & optimize a network



«*Rewire*» a destination
(might be easier on «virtual» component)

Build better connections btw stakeholders
Foster collaborative practices
Improve flow of information
Optimize knowledge transfer
Provide more «creative» environment
Strengthen links btw real & virtual worlds

measure & assess changes & effects

48

Remarks

Tourism ecosystems are *complex adaptive systems* & need to be studied as such

Methods & techniques to measure, model and interpret behaviors & phenomena are available

Appealing from a theoretical point of view

Can become an interesting tool to assist *practical* endeavors

and…

makes fun!

(remember Richard Feynman)

49

References

- Baggio, R. (2013). Complexity, Network Science & Tourism. Innsbruck: IFITT Education Group. Available at: http://www.iby.it/turismo/papers/rb_TourNetSci(IFITT).pdf.
- Baggio, R. (2017). Network science and tourism – the state of the art. *Tourism Review*, 72(1), 120-131.
- Casanueva, C., Gallego, Á., & García-Sánchez, M. R. (2016). Social network analysis in tourism. *Current Issues in Tourism*, 19(12), 1190–1209.
- Heidari, A., Yazdani, H. R., Saghafi, F., & Jalilvand, M. R. (2018). A systematic mapping study on tourism business networks. *European Business Review*, 30(6), 676-706.
- Merinero-Rodríguez, R., & Pulido-Fernández, J. I. (2016). Analysing relationships in tourism: A review. *Tourism Management*, 54, 122-135.
- van der Zee, E., & Vanneste, D. (2015). Tourism networks unravelled; a review of the literature on networks in tourism management studies. *Tourism Management Perspectives*, 15, 46-56.

- N.B. most of my papers at: http://www.iby.it/tourism

50