

Unending inductive/deductive methods in Complex Social systems

Complexity and method in the Social Sciences,
University of Warwick,
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Complex Systems Research Centre,
Cranfield University

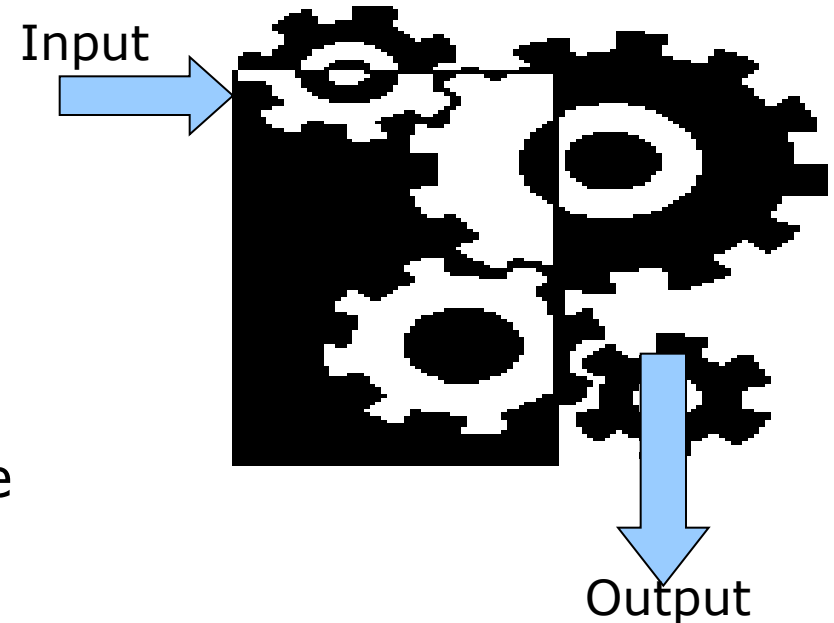
- In the natural sciences, for some problems we can do repeatable experiments repeatedly - prediction. Can find robust 'laws'. Induction. Can deduce specific behaviour - Deduction
- In social/biological systems repeatable experiments are difficult because of memory, changing environment, learning entities. In everyday life we learn pragmatically rules that work well enough not to kill us immediately.
- Is 'understanding' about 'describing what is going on and what will happen'? Is explanation about prediction? Or can knowledge (dice) 'explain' lack of prediction? Do system dynamics explain or describe? Or show which assumptions hold?
- Even apparently similar People/Entities in evolved systems have internal levels that are marked by heterogeneous histories, and differing responses.

- Are there underlying natural laws for social science?
- Or is social science more about 'describing' and noting regularities? Constructing classifications and taxonomies? Clash of physiological or evolutionary (cladistic) markers.
- What can complexity science do for social science? Social systems **are** evolving, complex systems – with cooperative and competitive interactions over multiple time scales
- Full of pragmatically learning individuals/groups with diverse interpretive frameworks and histories. All responding to individual/group reward/punishment signals locally.

My (very reasonable) starting point

- Physics must be right (and me too)
- A “system” is just a set of interacting components (possibly agents), whose behaviour can be predicted providing we can define their behavioural rules, and their interactions
- Problems, including social systems, can be modelled, understood and hence “solved”

And life is therefore:



**But it is a view with
No Uncertainty –
No Learning!!!
NOT A SOCIAL SYSTEM!**

Newton's Laws work for the Planets: But what about evolved Systems?

- Develop the equations of population dynamics
- Measure birth and death rates, cash flows, sales, growth rates....

$$\frac{dx_1}{dt} = F(x_1, x_2 \dots x_i, \dots b_1, m_1, \dots) \cdot x_1$$

$$\frac{dx_i}{dt} = F'(x_1, x_2 \dots x_i, \dots b_i, m_i, \dots) \cdot x_i$$

$$\frac{dx_{i+1}}{dt} = F''(x_1, x_2 \dots x_{i+1}, \dots b_{i+1}, m_{i+1}, \dots) \cdot x_{i+1}$$

Species
Growth and
decline

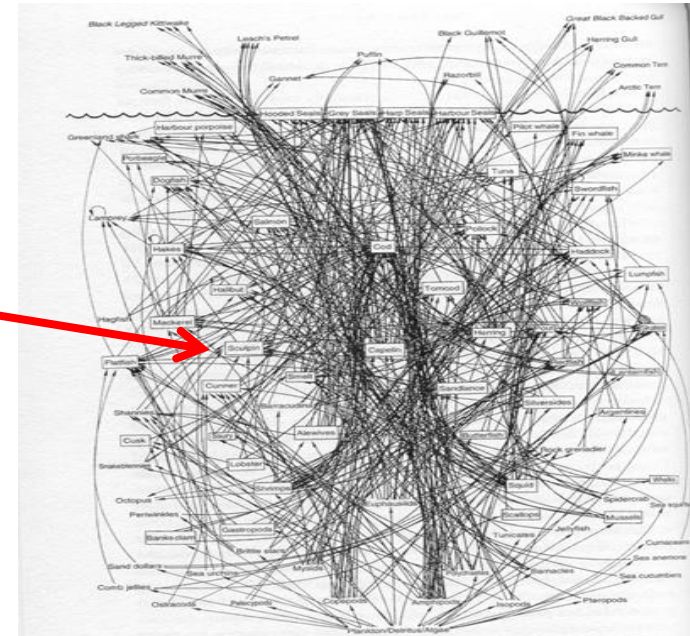
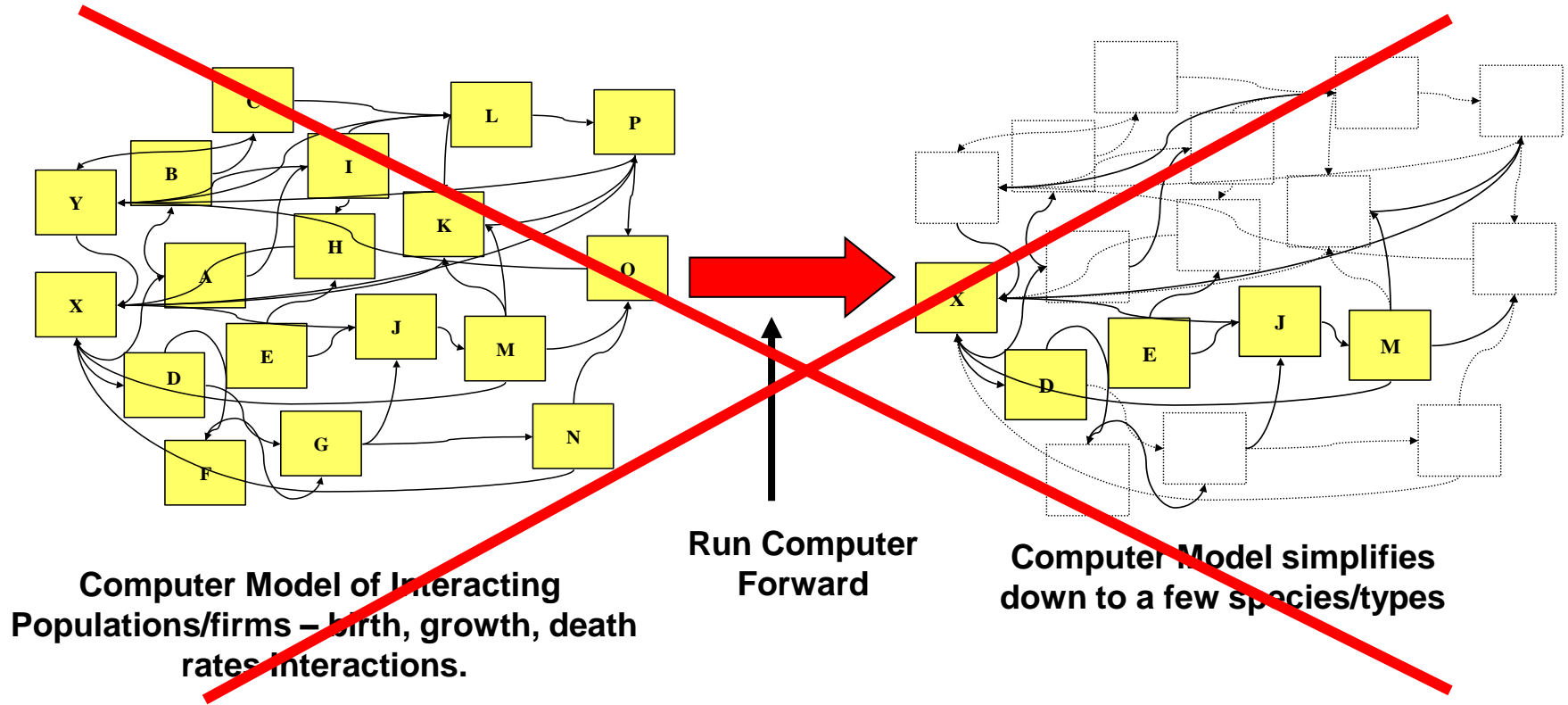


Figure 18. A portion of the food web in the North Atlantic Ocean. (Image courtesy of David Lavigne, reprinted by permission.)

Firm Types
Growth and
decline



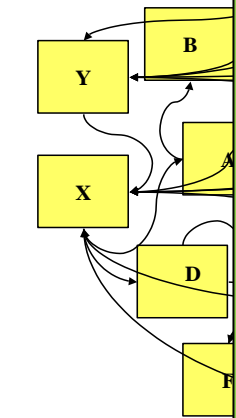
- We can construct and calibrate dynamical equations that describe the growth and decline different species or types of firm in the system
- The nodes are 'species' in biology or chemistry (population Dynamics) or types of (economic) activities in human systems with many parallel supply chains and distribution systems..



- We can construct and calibrate dynamical equations that describe the growth and decline different species or types of firm in
- The no Dynam with m

But in Reality this does not happen!
Why? Because each 'type' in reality has micro-diversity and the vulnerable go first, others try harder and so the parameters CHANGE!

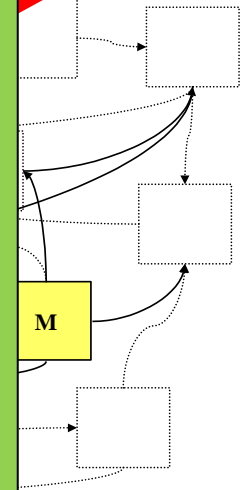
The average behaviour is calculated from the individuals - individuals are not directed by the average!!!!
The model has differential survival –
But NOT behavioural plasticity!!!



Comput
Populations/

rates interactions.

tion
systems
ms..



ifies
types

- 1 Assume that I can define a system with a **BOUNDARY** around it separating it from the **ENVIRONMENT**
- 2 Assume that I can **CLASSIFY** the system's internal elements involved in the question being asked (X, Y, Z etc.). Over time some types have disappeared and new ones have occurred. Evolution!
- 3 Assume that the behaviour of X, Y and Z will be given by that of their average **STEREOTYPES**. (No micro-diversity –no adaptive behaviours, or local knowledge)

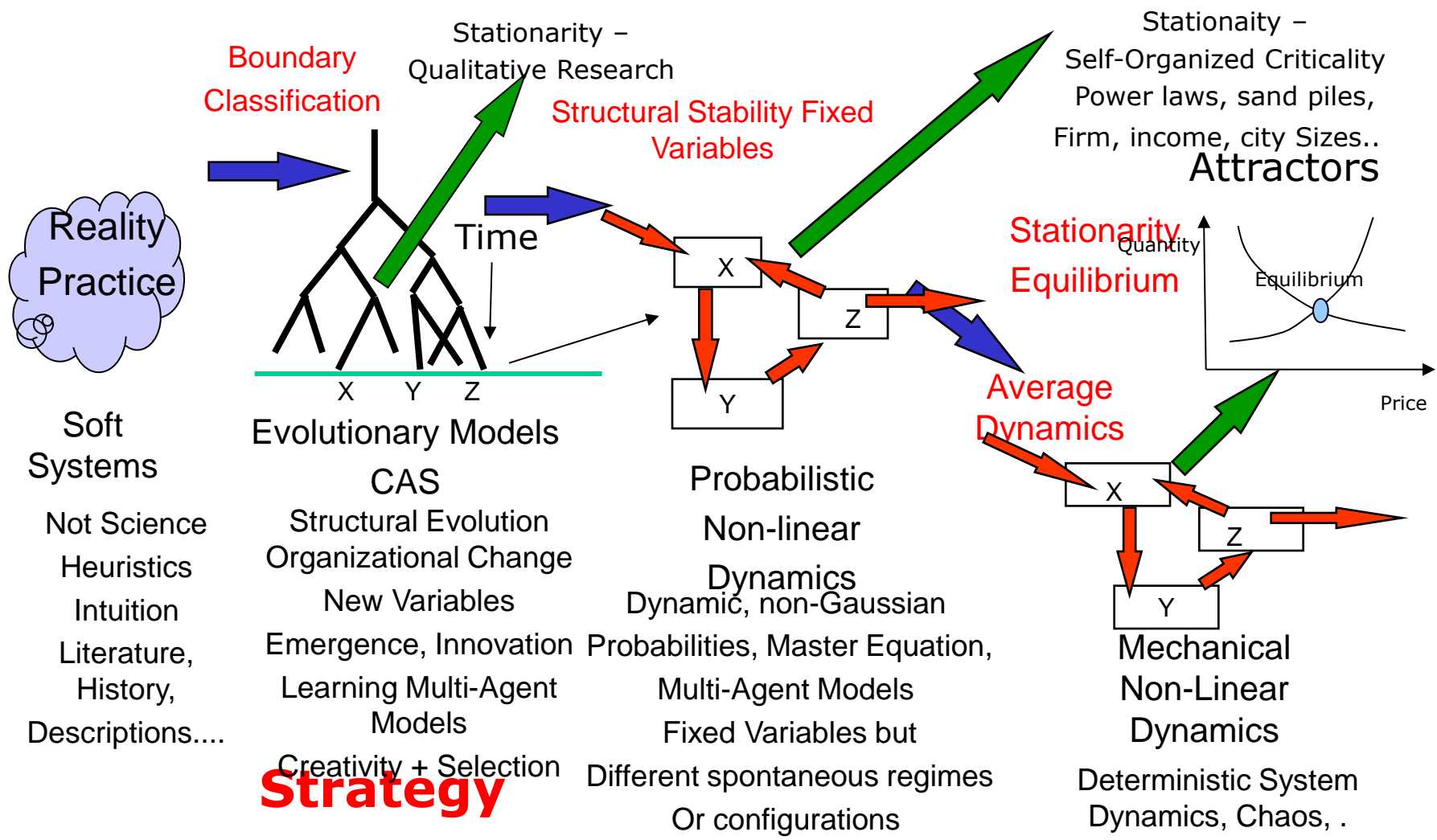
4. Assume events occur at their **AVERAGE** rates (No luck or local circumstance)
Non-Linear Dynamics

5. Assume Equilibrium

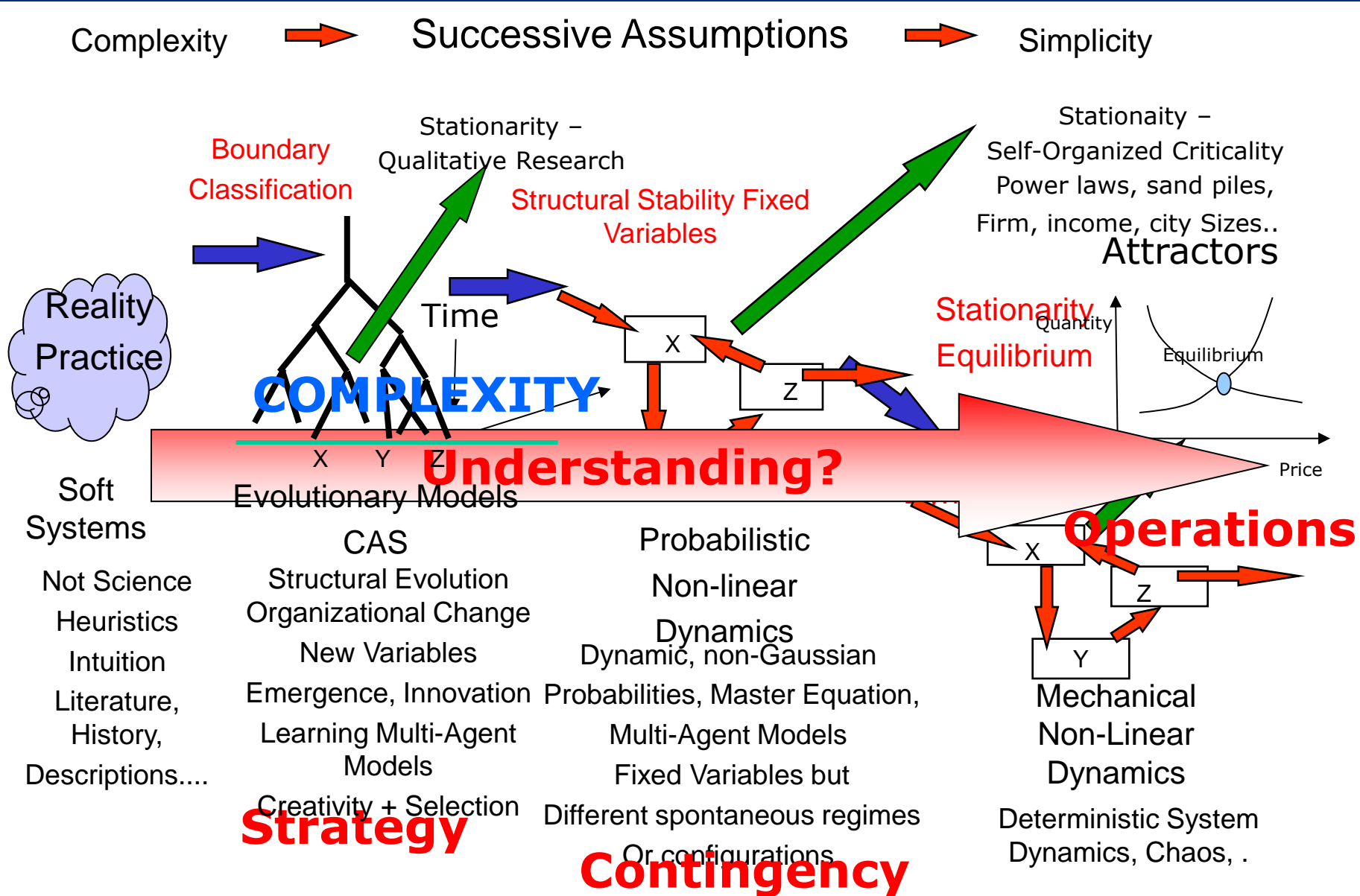
4. Assume a stationary distribution
Self-Organized Criticality

From REALITY to UNDERSTANDING?

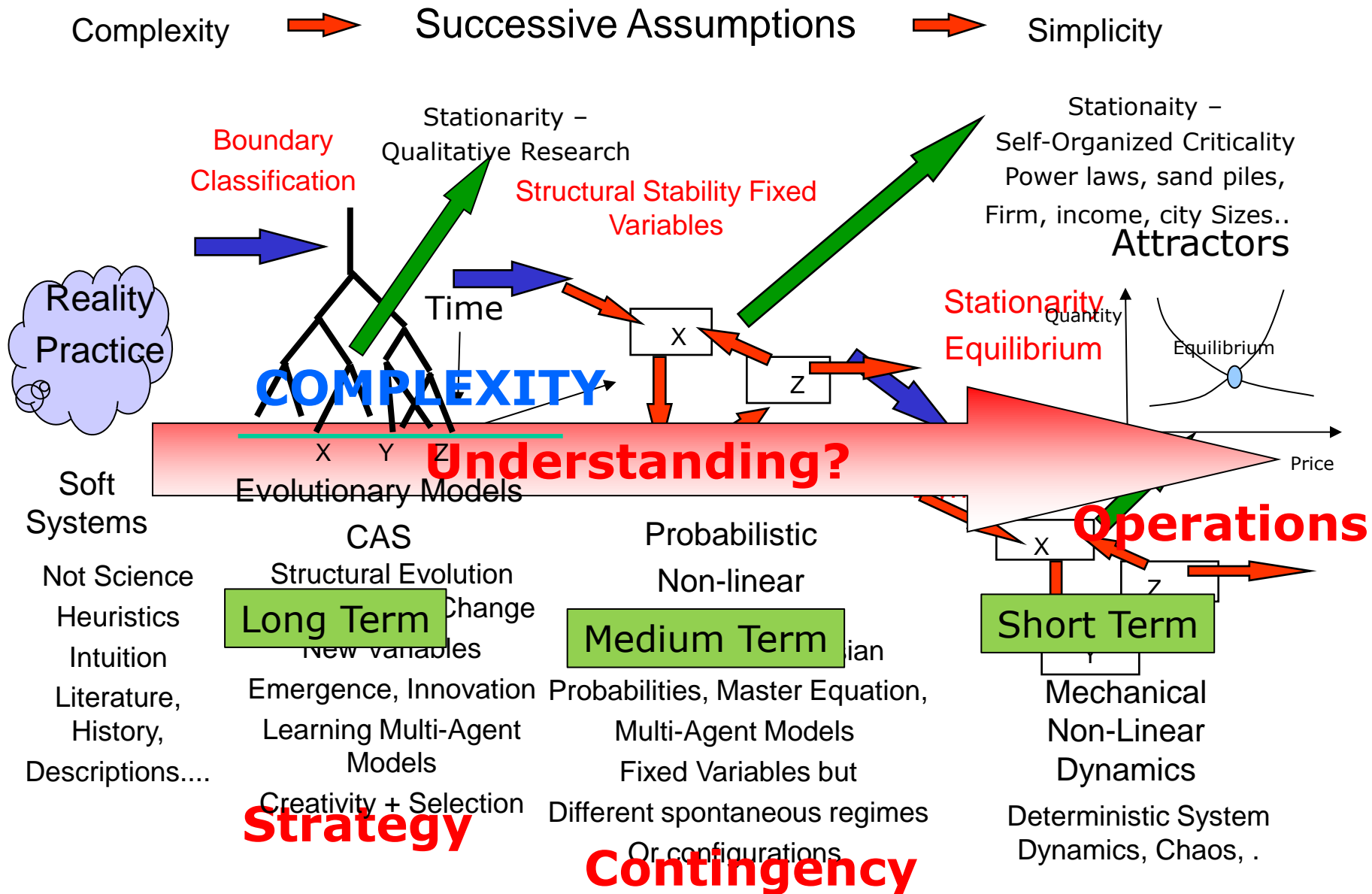
Complexity → Successive Assumptions → Simplicity



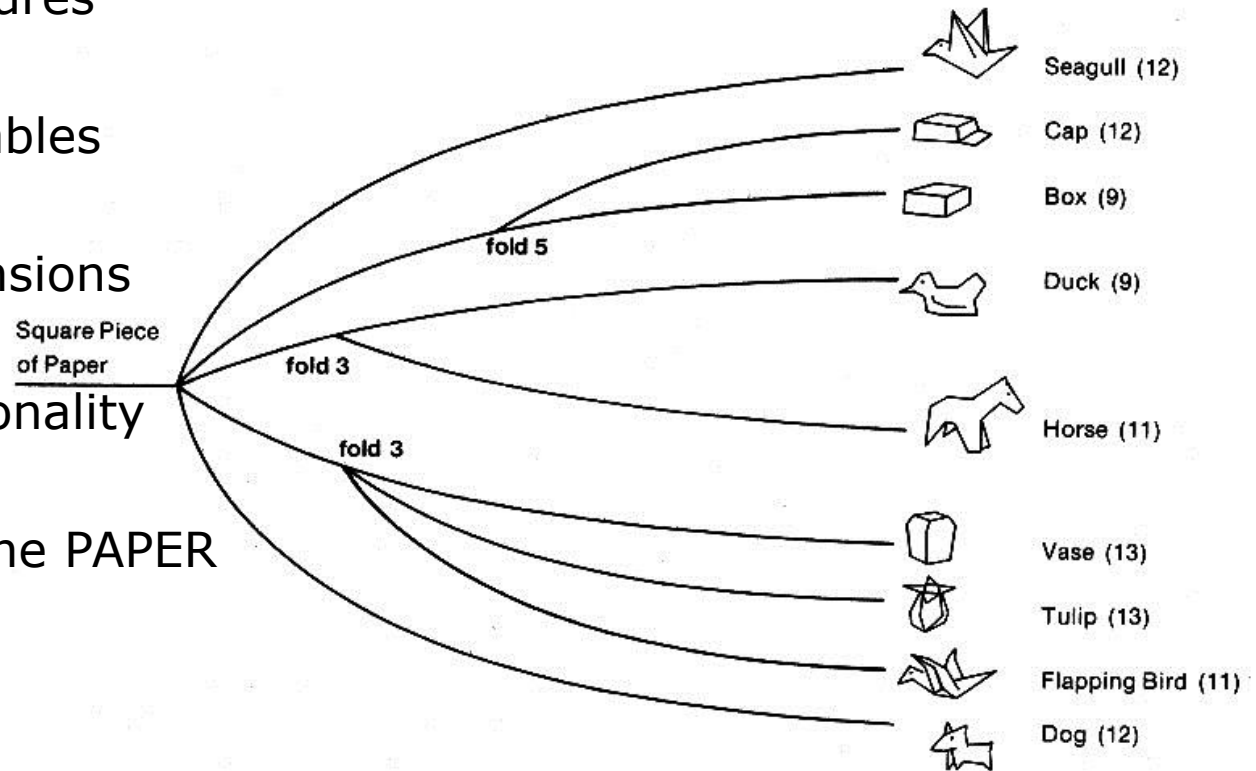
From REALITY to UNDERSTANDING?



From REALITY to UNDERSTANDING?

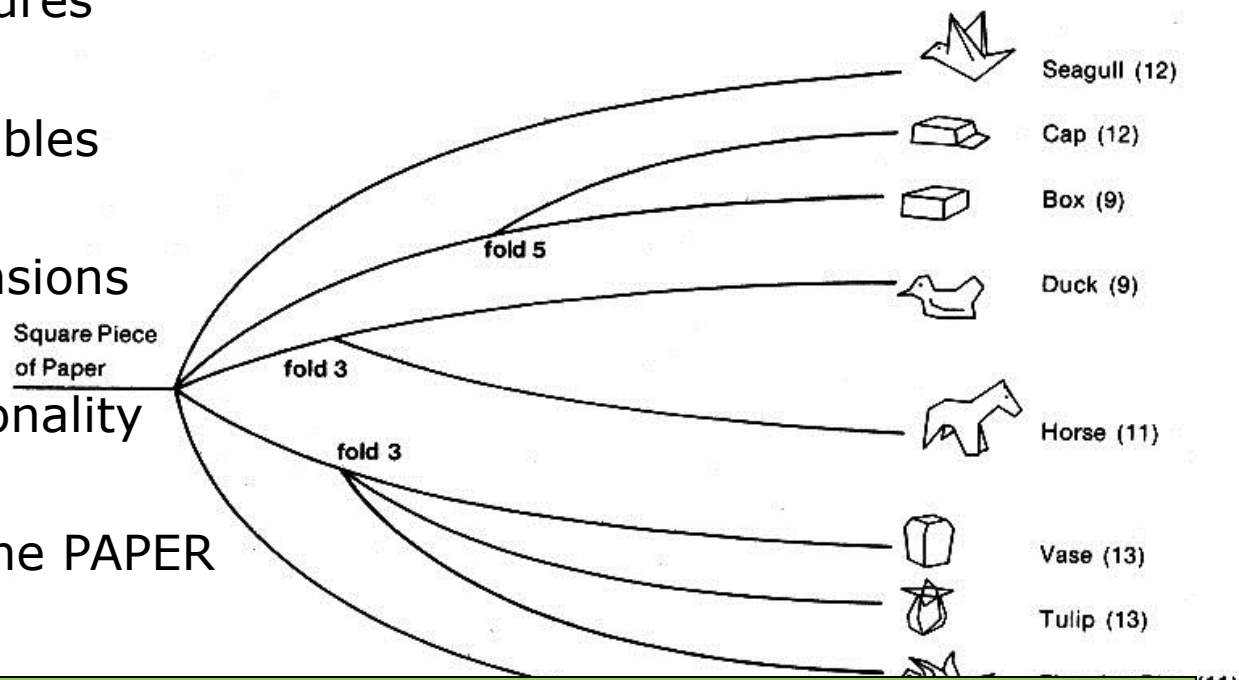


- Emergent Features
- Emergent Variables
- Emergent Dimensions
- Emergent Functionality
- Physics deals with the PAPER



1986 Ev of Multifunctionalism in Ezymes, J McGlade and P Allen,
Can J of Fisheries and Aquatic Sciences, vol 43, No 5

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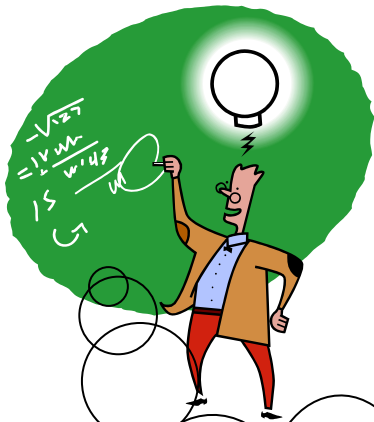


**BUT, "Selection" can occur on the basis of the EMERGENT properties and features of the objects!
- They also form a higher level system!**

1986 Ev of Multifunctionalism in Ezymes, J McGlade and P Allen,
Can J of Fisheries and Aquatic Sciences, vol 43, No 5

- Instead of proposing a stable Confucian hierarchy, the Dao De Jing says:
- “That which can be spoken of is not eternal. That which is named is not the eternal name. Our new thoughts shape how we think and act and how we are presently disposed to think and act disciplines our novel thoughts. It is the **underdetermined** nature of the world that makes it, like a bottomless goblet, inexhaustibly capacious!”
- So, if this brilliant evocation of Evolutionary Complexity was known 2500 years ago, what has science got to add?

- 2500 years later we can build 'interpretive frameworks' – MODELS! Even if mechanical models are 'wrong' – less than the truth - they can still be worth building.
- Intelligence can reside in the modeller and/or in the model. Complexity models will always contain noise, randomness and non-linearities that can lead to structural evolution!
- These are not predictions but are experimental explorations – attempts to imagine possible futures



Old Science

Equilibrium
Stability
Optimality
Rationality
Perfect
Knowledge

Social Science

People
Preferences
Values, ethics, morals
Beliefs
Knowledge
Culture
Psychology
Rewards/Risks
Decisions
Descriptions
Surveys,
semi-structured
Data, Statistics
Models
.....

Complexity Science

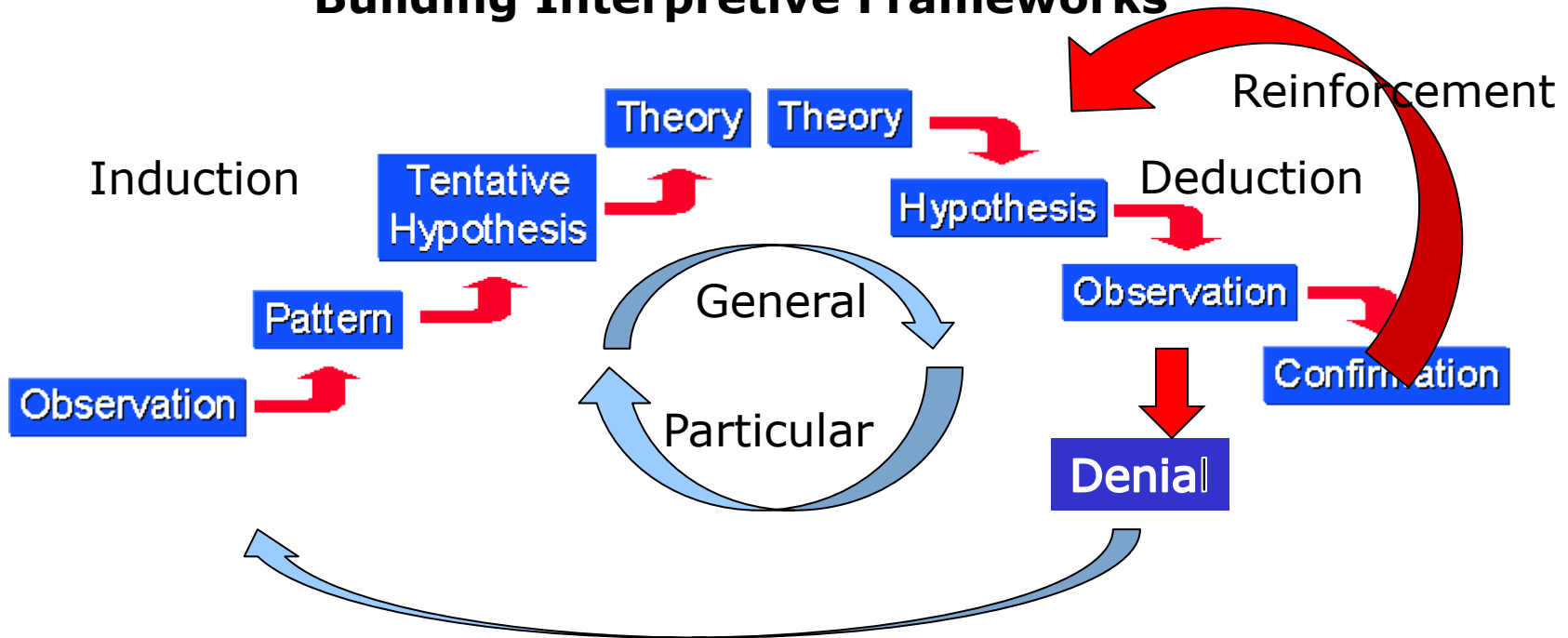
Non-Equilibrium
Dynamics
Evolution
Attractors
Bifurcations
Chaos – Edge?
Co-evolution
Imperfect Learning
.....
On-Going Evolution?



Metaphors?
Confucian?
Daoist?

Science is about finding general Rules that allow us to predict particular cases.

Building Interpretive Frameworks

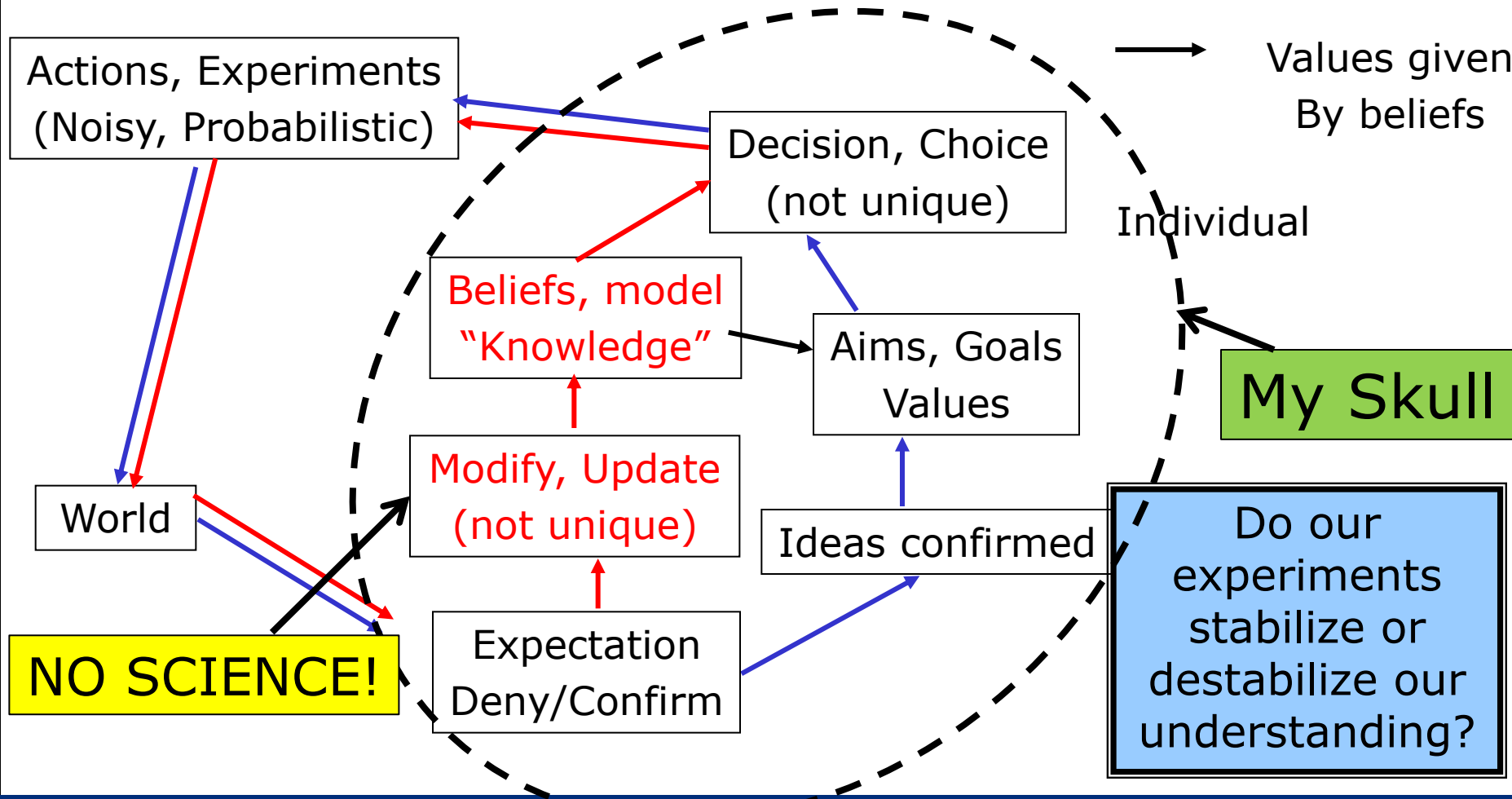


But, in an evolving world this is an unending process!
Micro-Diversity leads to new behaviours and Learning.
Learning changes the world, requiring more learning!

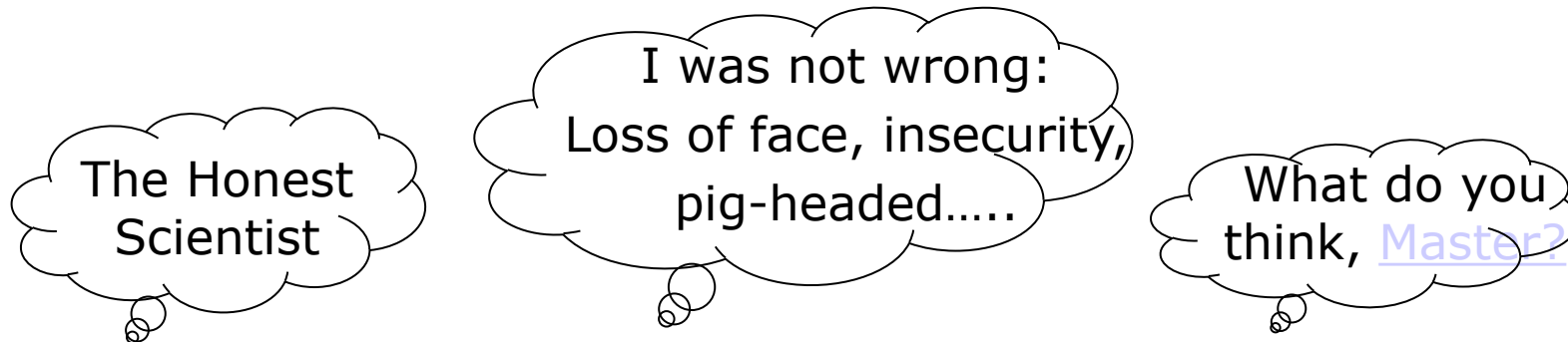
Social Science or just muddling through?:

Our interpretive framework results from our experiences – which are guided by our interpretive framework!

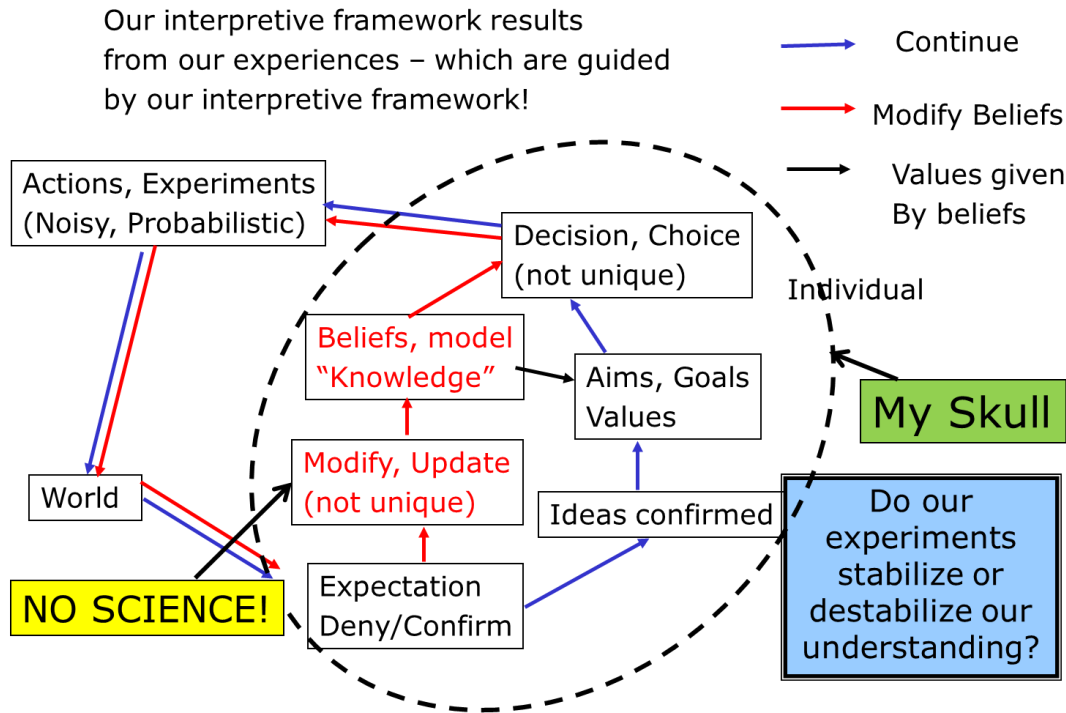
- Continue
- Modify Beliefs
- Values given By beliefs



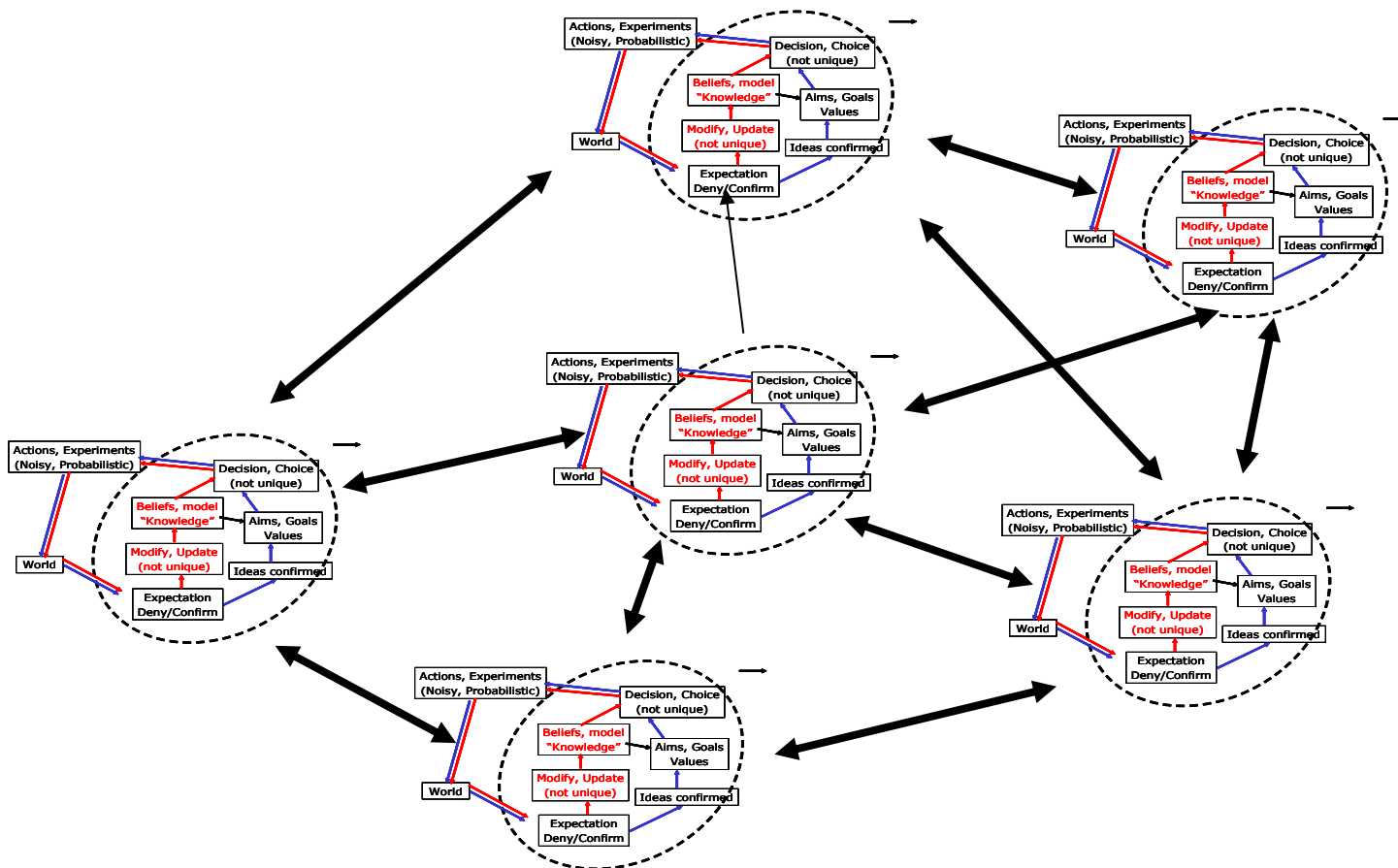
Pragmatism is probably all we have. But are we honest?



Our interpretive framework results from our experiences – which are guided by our interpretive framework!



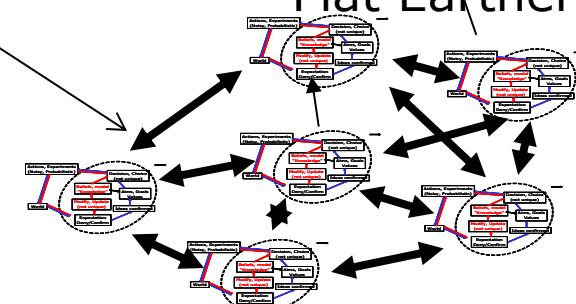
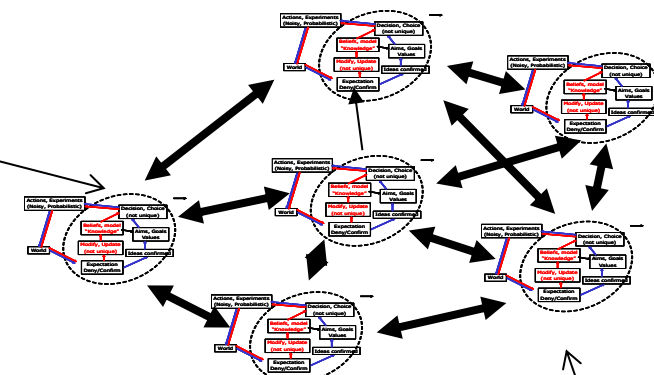
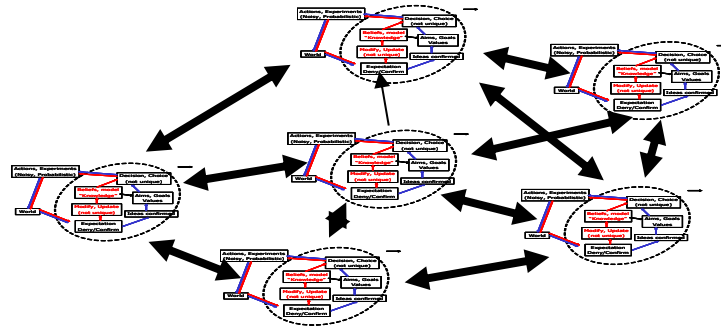
- Incoherence can only end in coherence
- Open exchange can lead to emergent collective capabilities
 - Agreement might not be 'the truth'.



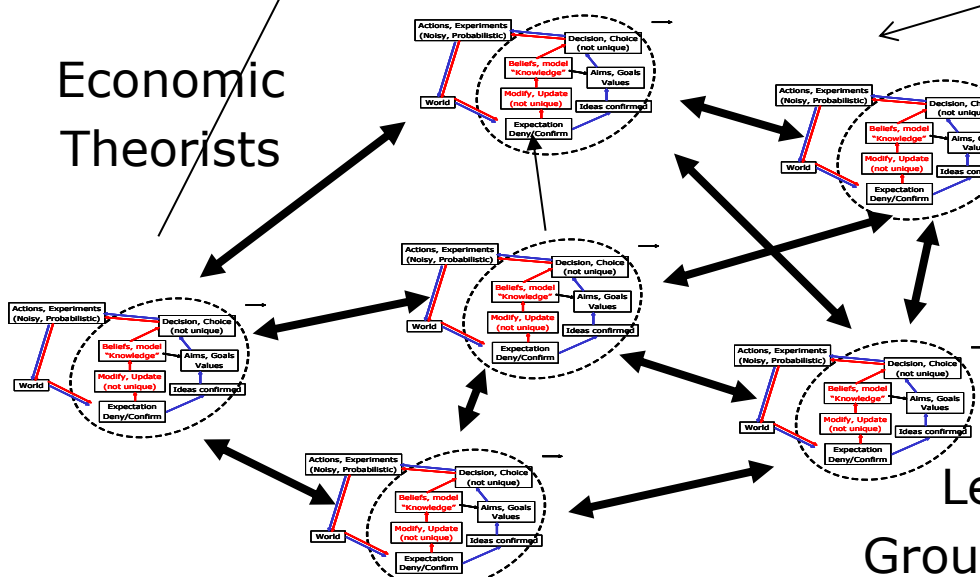
Schumpeterians...

Pragmatists

Flat Earthers



Economic Theorists



Collective performance will
Lead to retention of 'successful'
Group identities and ethical behaviour

Complexity-Agent Based Urban and Regional Planning:

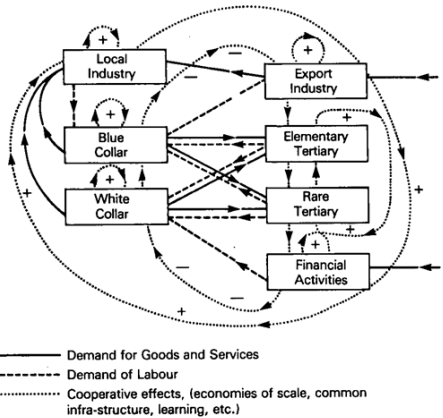
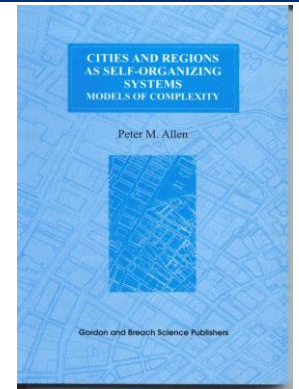
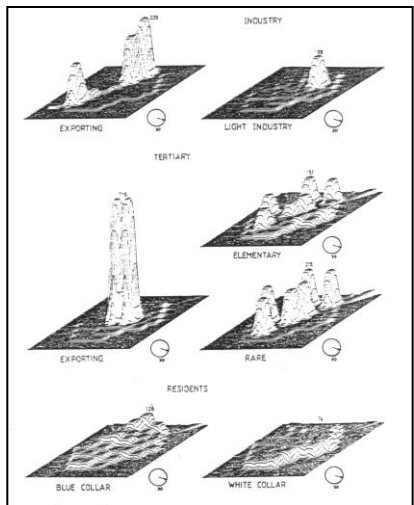
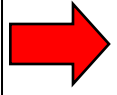
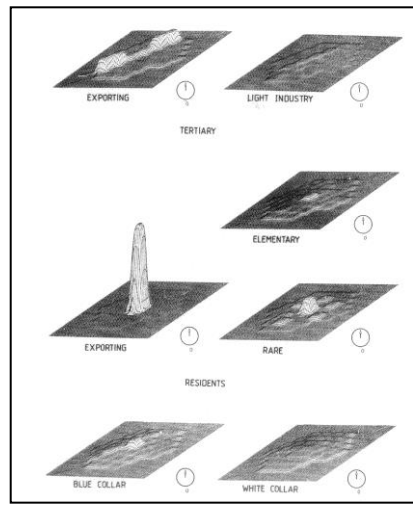


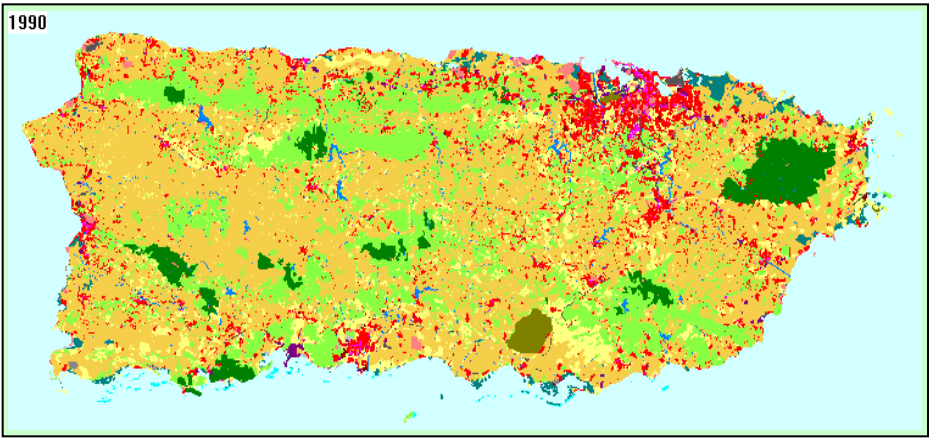
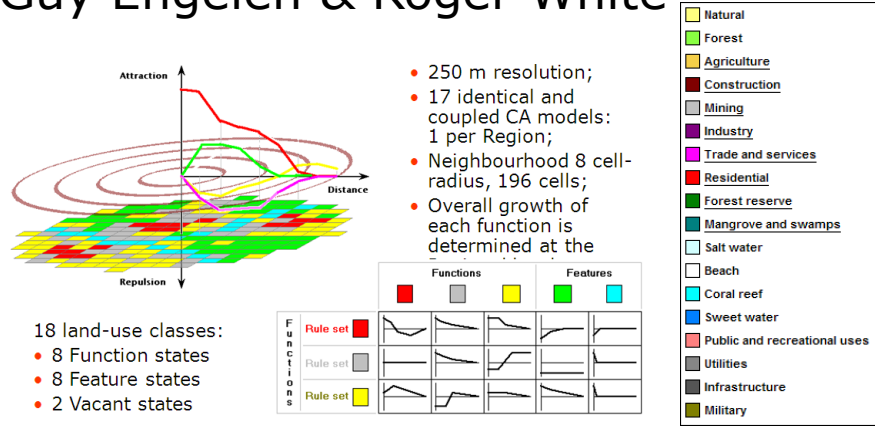
Figure 9.1 The scheme of interaction for an intraurban evolution.

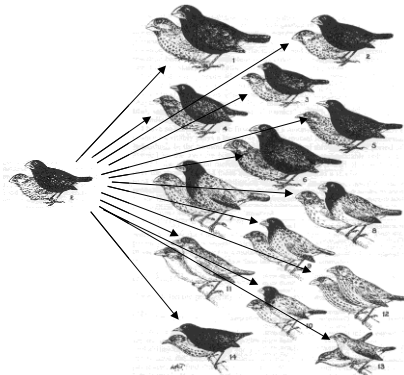


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Great Read!

Brussels, Detroit, USA, Senegal, Rhone Valley, Marina Baixa, Argolid, West Bengal, Nepal,....

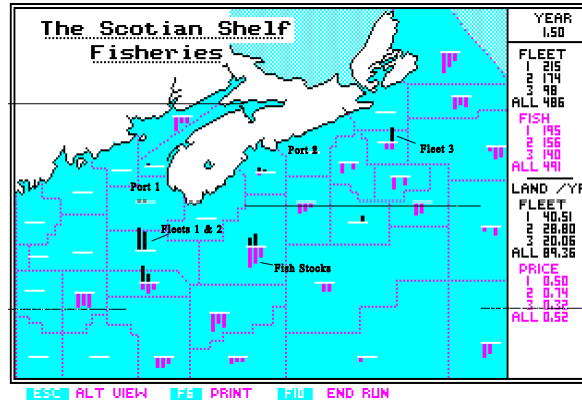
Guy Engelen & Roger White



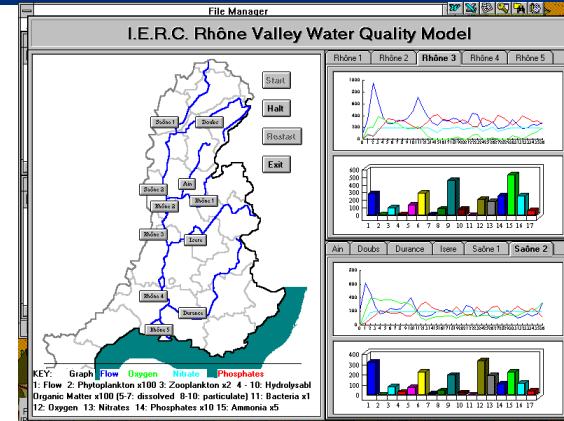


Darwin's Finches

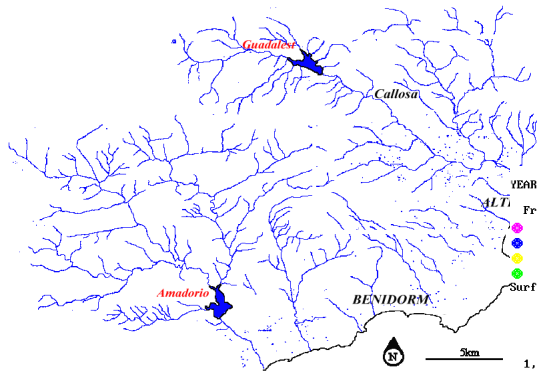
Predicting Diversity



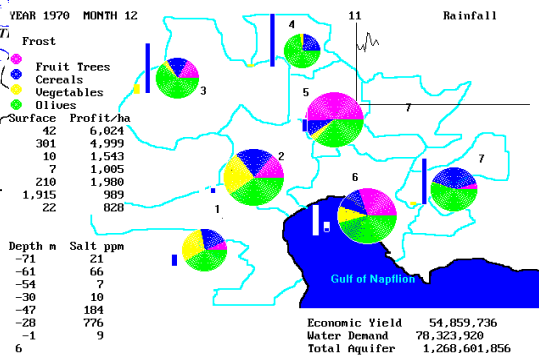
Canadian Fisheries



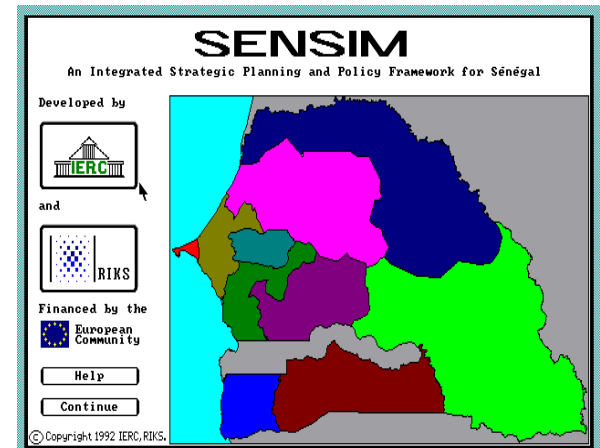
Rhone Valley



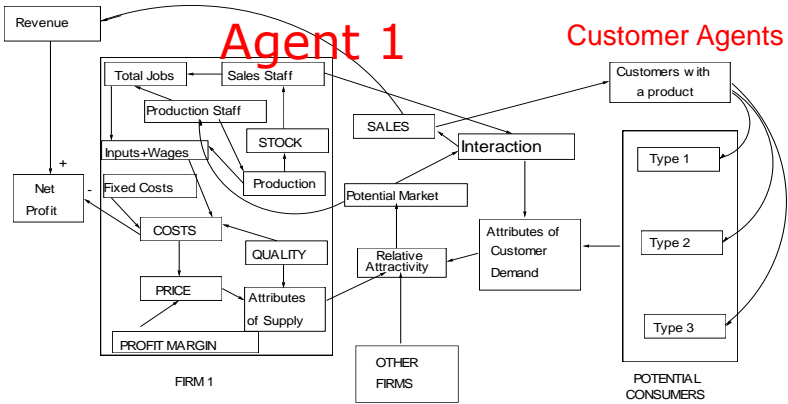
Marina Baixa



Argolid Valley

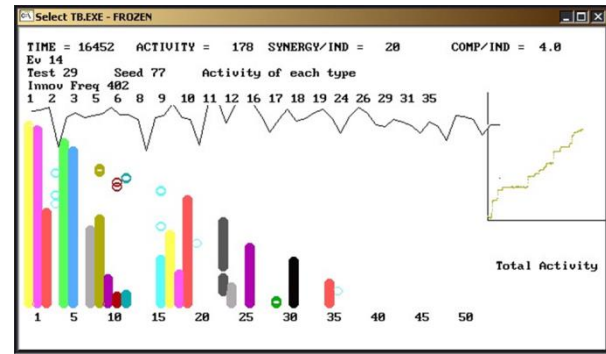


Senegal

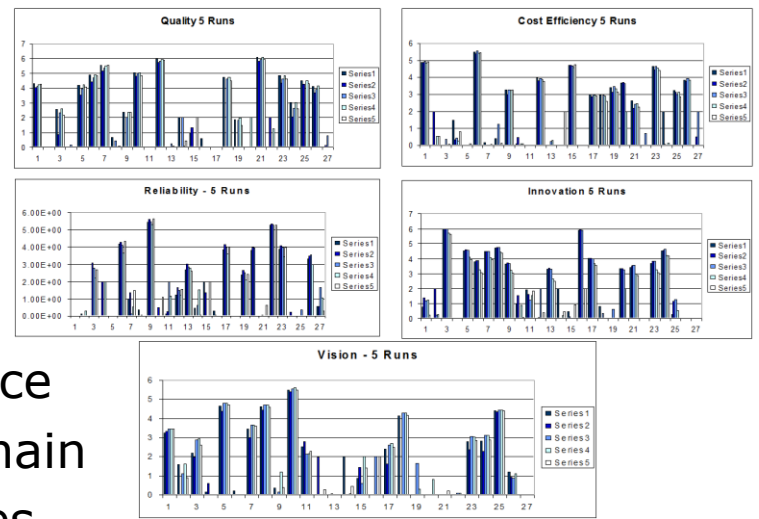
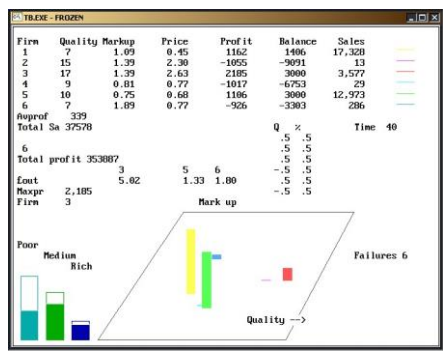


Strategy on Profit Margin, Quality, R&D, Design....

Economic Markets

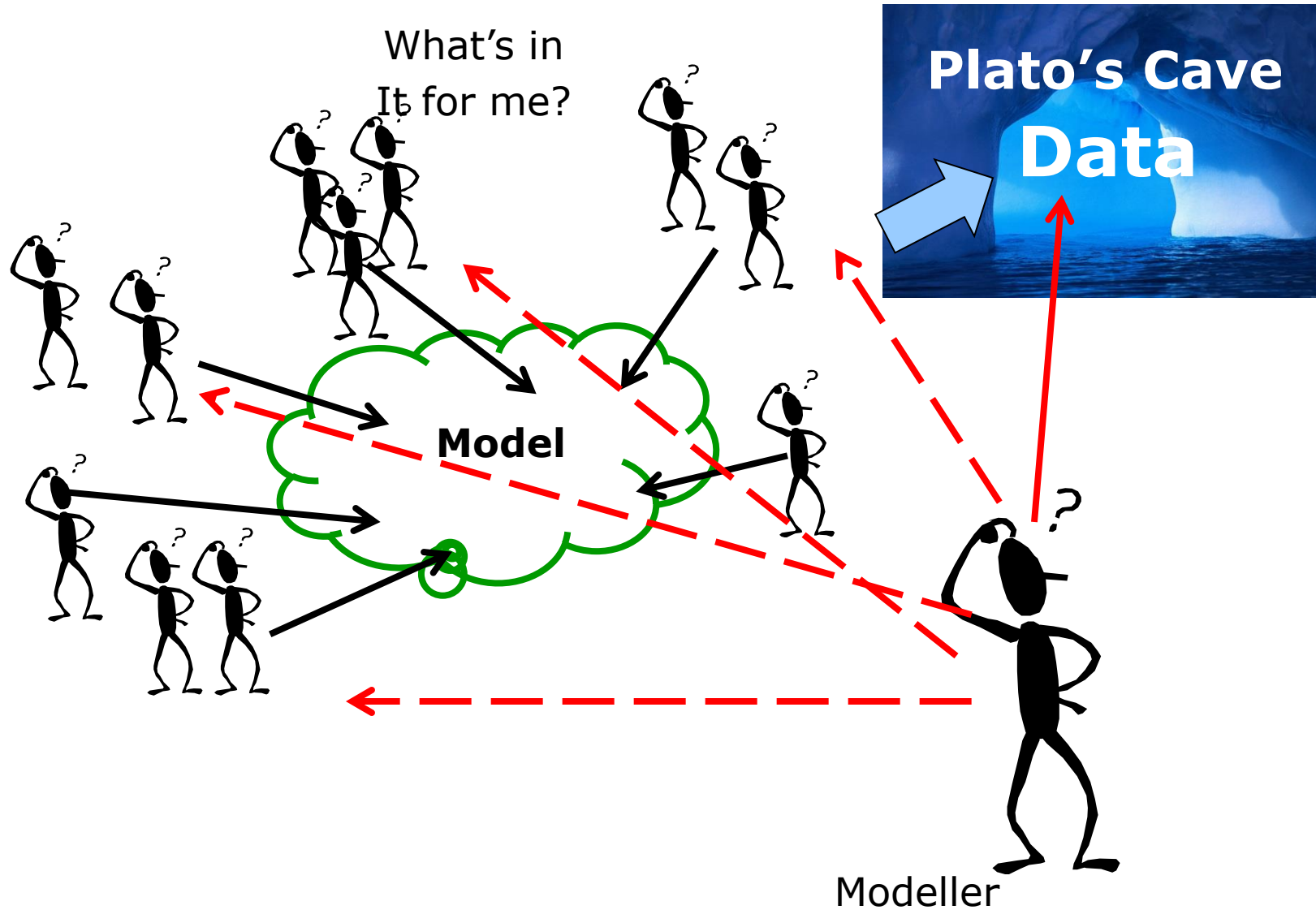


Manufacturing Practices and Techniques

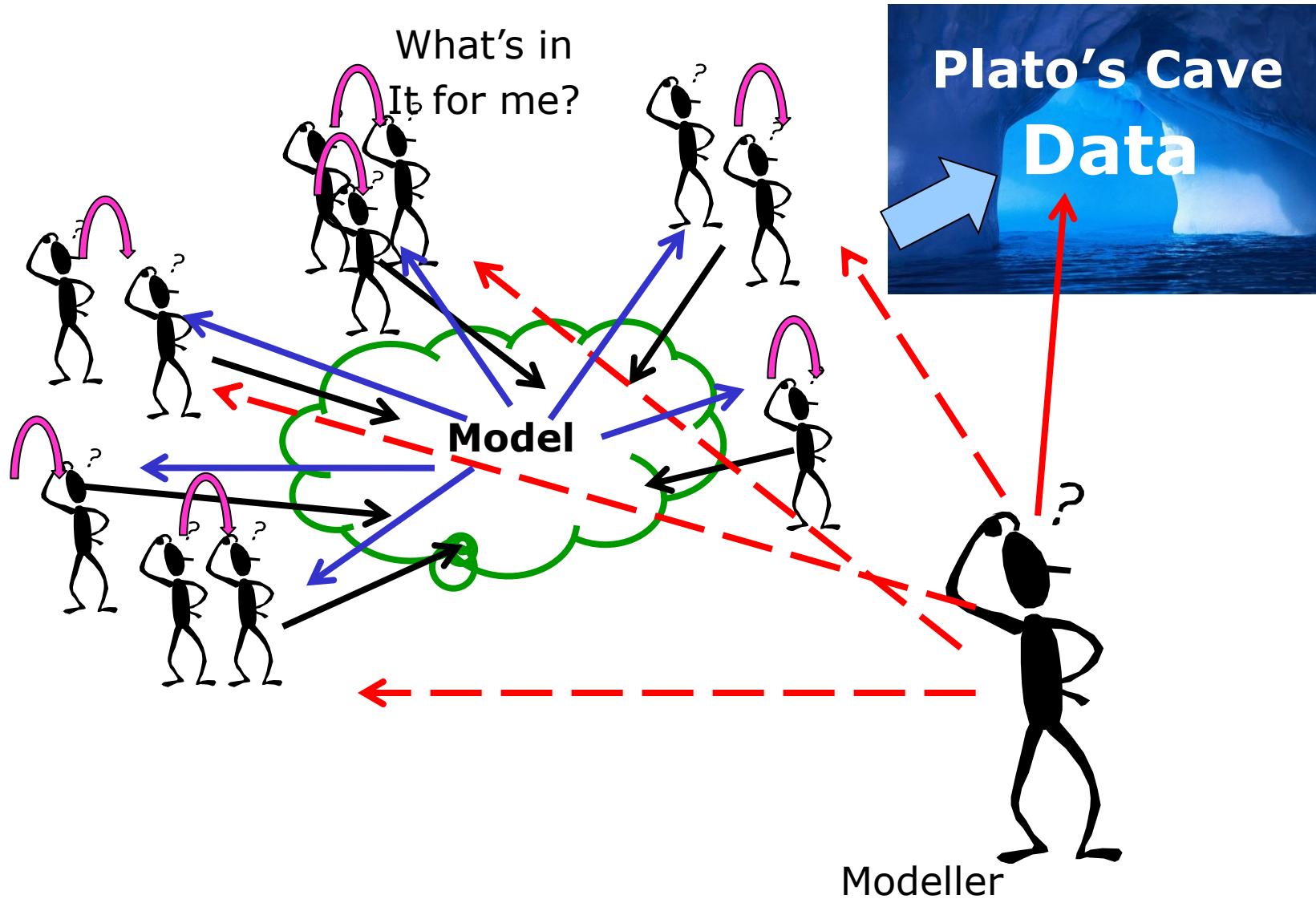


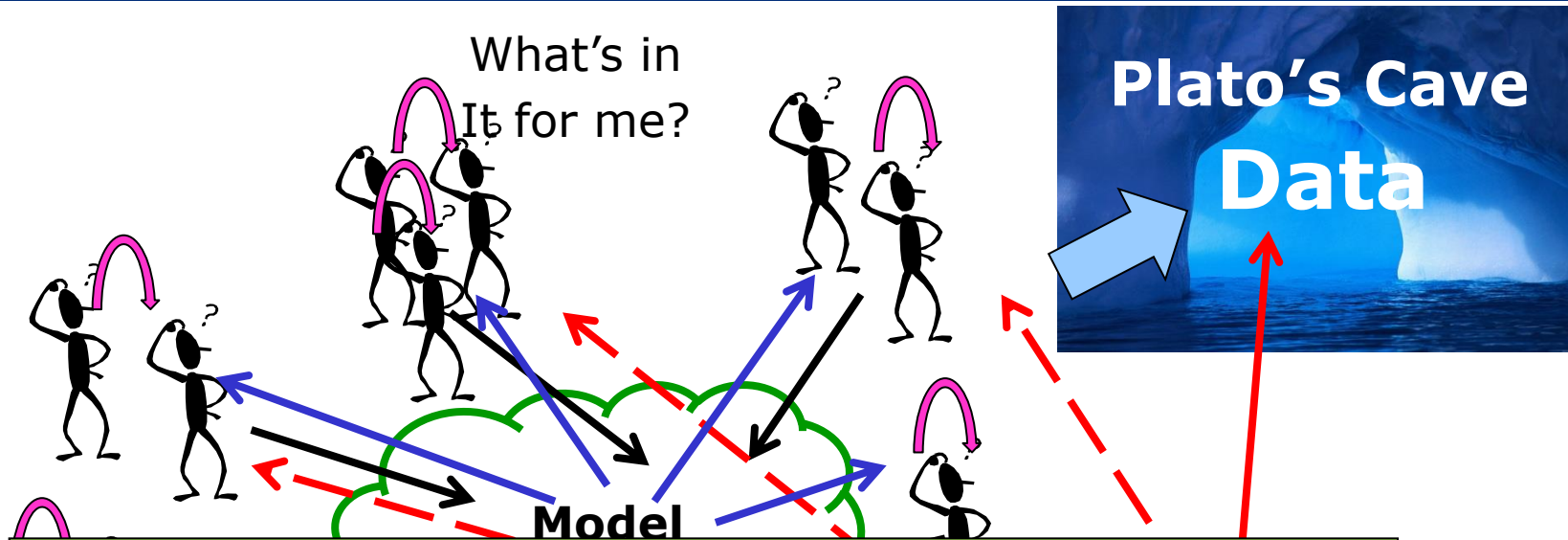
Aerospace Supply Chain practices

But REFLEXIVITY occurs in Agent Based Models:



But REFLEXIVITY occurs in Agent Based Models:





Such a Model could be a tool for building Social Cohesion – e.g. Climate Change but Only if you already have a Community!

If you haven't got a Community You can't get one easily....

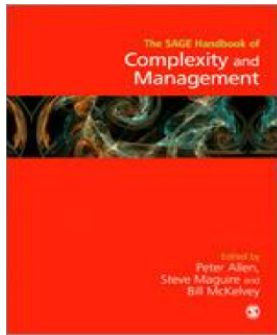
Modeler

- **Traditional Science** depends on **Repeatable Experiments** – essentially Closed Systems – and provides Popperian Knowledge. The behaviour of the elements under study is **not changed** by their experiences. Molecules don't get bored or angry and have a poor sense of humour!
- **Social Science** must deal with evolutionary “**Creative Destruction**”. **Repeatable experiments not really possible**. New things emerge, new structures form with emergent features and capabilities, while other things disappear.
- ‘Understanding’ is about facing what **cannot** be understood. The ‘micro-MESS’ is the **engine of resilience and future evolution** – the opaque core of evolutionary complexity.

- When we look at a system/network/organization **all that we see are things/behaviours that happen to have been created, minus the non-viable and the unlucky!**
- This means that what we will find does **not** necessarily 'make sense' and many elements may have no role or function. We cannot necessarily understand 'better' by analysing **more data**.
- This affects the nature of 'explanation' since we cannot always attribute functionality to elements. It also makes the **outcomes of innovations unpredictable**
- Models with noise, randomness and non-linearities **can tell us things that we didn't know and weren't in the data!**

- In **Social Science** we have **REFLEXIVITY**. Different agents behave according to their own **acquired interpretive frameworks**, which continue to change with their 'resulting' experiences and changing the variables and model qualitatively.
- And when agents see the **outcomes** of a model, they may modify their **internal representations** and hence their behaviour. This would then **INVALIDATE** the model.
- We could **INCLUDE** the changes in participating agents' representations as part of the model. (Machiavelli) Or include agents anticipating other agents 'learning' in their internal representations. Machiavelli **SQUARED!!!** Etc.
- This is not a solved problem!

- Complexity and Evolution involve **changing** systems of **changing** elements. Both Qualitative and Quantitative changes happen as structural instabilities (new variables) of the dynamics occur. Qualitative Research is important
- **Our interpretive frameworks (Models) do not make predictions about the world, but about themselves.** We have an unending deductive/inductive loop that is the instrument of our exploration/reflection. A model may warn us of possible problems (e.g. climate change, limits to growth) and increased “credibility” may make evasive action **MORE** likely.
- **Our understanding and interpretive frameworks are just part of the Evolving Complex World.**



The SAGE Handbook of Complexity and Management

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University of California, Los Angeles

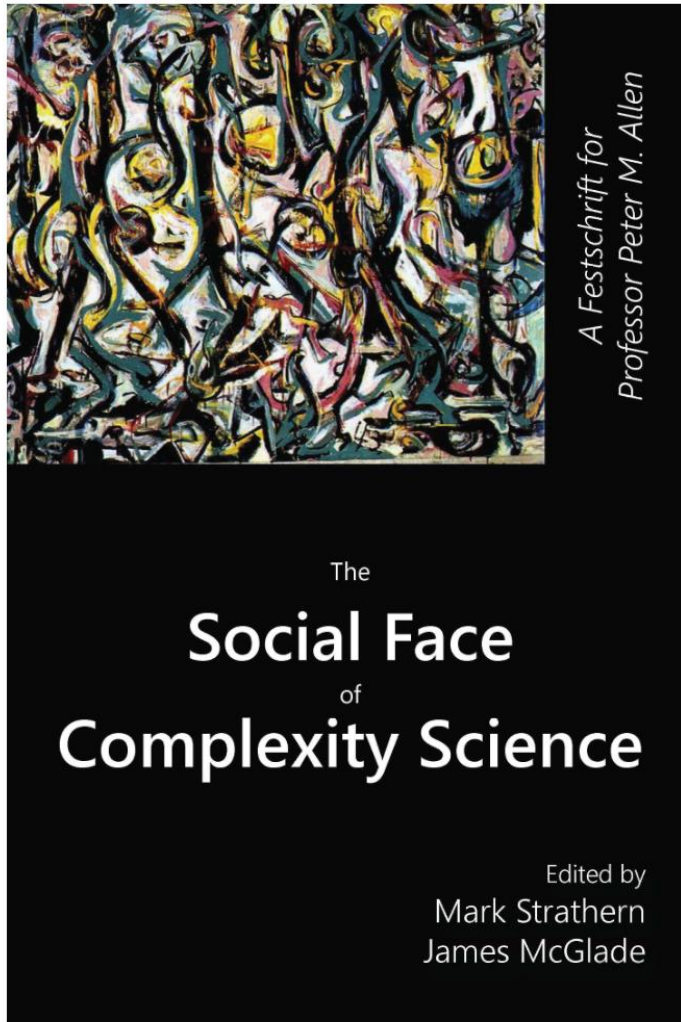
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February 2011, 648 pages

The SAGE Handbook of Complexity and Management will be the first substantive scholarly work to provide a map of the state of art research in the growing field emerging at the intersection of complexity science and management studies. Edited and written by internationally respected scholars from management and related disciplines, the Handbook will be the definitive reference source for understanding the implications of complexity science for management research and practice.

Part One: Foundations introduces complexity science and its implications for the foundations of scientific knowledge, including management knowledge

Part Two: Applications presents the numerous ways in which complexity science models and tools, as well as complexity thinking, are being applied to management and organizational phenomena and the insights gained as a result

Part Three: Interfaces highlights how complexity science is transforming various non-management fields and, in so doing, creating exciting interfaces for bridging between management and related disciplines



Emergent Publications
ISBN 978-1-938158-13-1

An interesting collection of very diverse papers written by some of the friends who have worked with me over the years.

<http://www.amazon.com/The-Social-Face-Complexity-Science/dp/193815813X>