

BoF-PSS Simulation Seminar
25-26 August 2011



financial
network
analytics

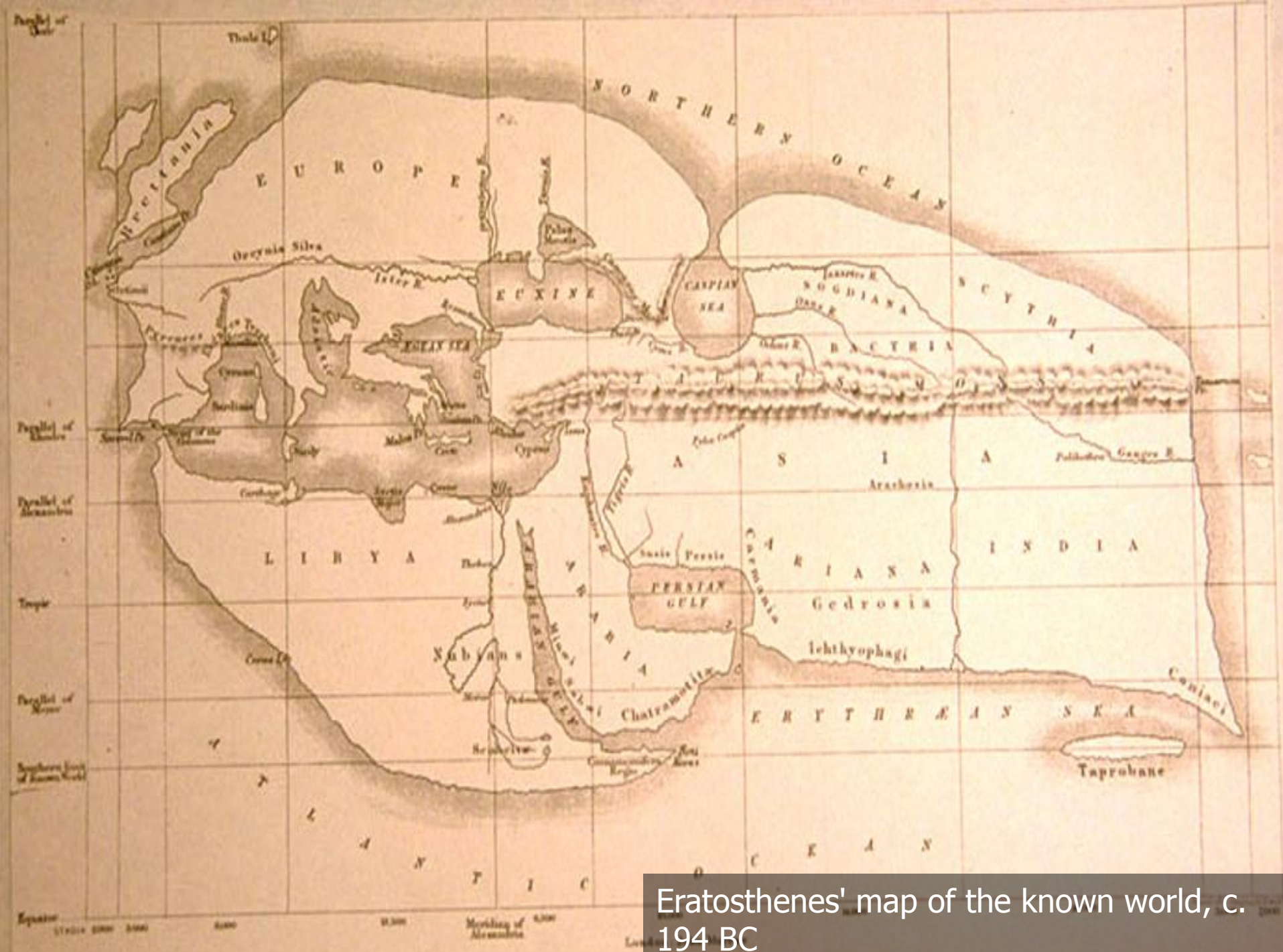
Visualizing Complex Financial Networks

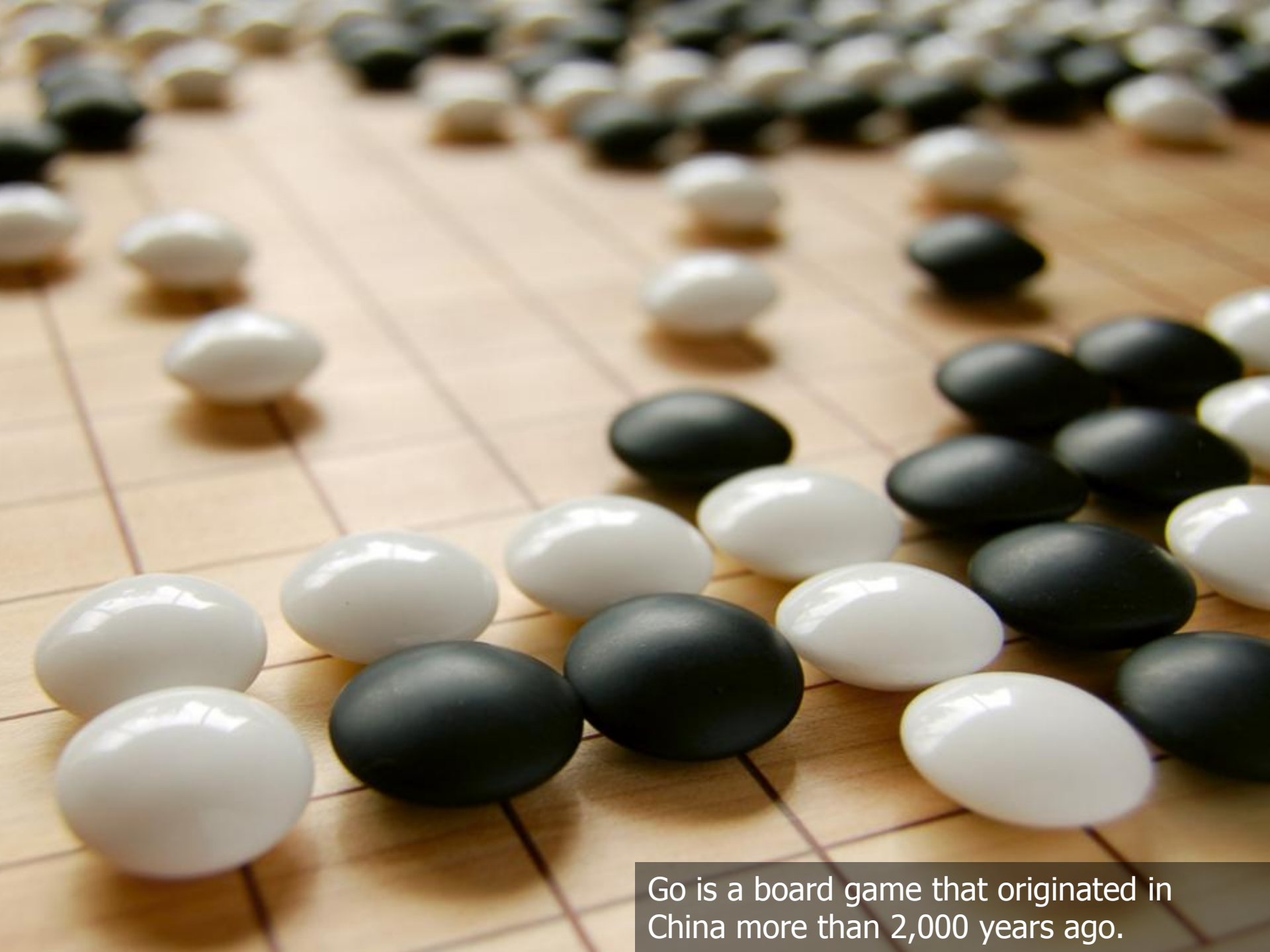
New understanding of the financial system and
implications for policy makers

Kimmo Soramäki
Ines Salpico Soramäki
www.fna.fi



Katsushika Hokusai. The great wave off Kanagawa ~1830





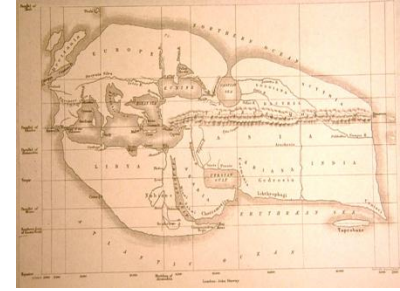
Go is a board game that originated in China more than 2,000 years ago.

Data tsunami

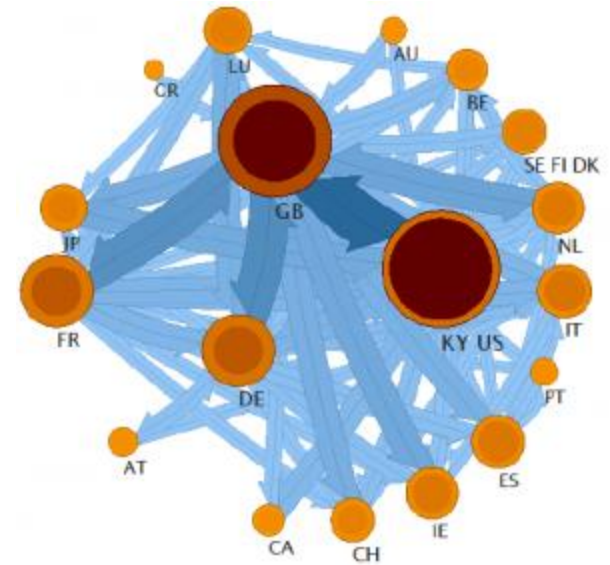


- Digital information is doubling every 1.2 years
- Regulatory response to recent financial crisis was to strengthen macro-prudential supervision with mandates for more regulatory data
- The challenge will be to understand and analyze the data (public, commercial and regulatory)
- Data enables “Analytics based policy”, i.e. the application of computer technology, operational research, and statistics to solve regulatory problems

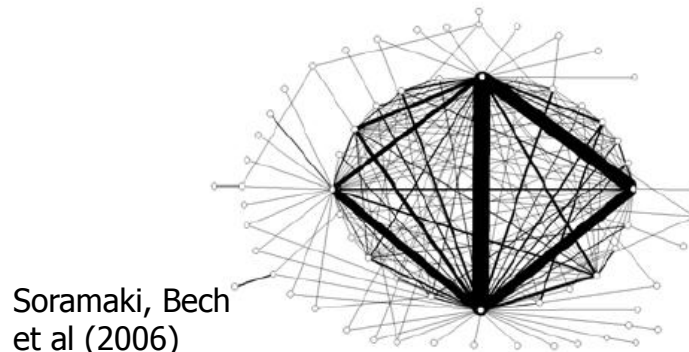
Network maps



- Recent financial crisis brought to light the need to look at links between financial institutions
- Way to present data. Mapping of the financial system has only begun
- Reduce uncertainty about interconnections



Garrett, Mahadeva and
Svirydenska (2011)



Soramaki, Bech
et al (2006)

Intelligence



- Financial crisis are different and rare
- Pattern recognition is hard for computers -> the best Go programs only manage to reach an intermediate amateur level
- The patterns to be recognized must be frequent enough for computers to learn
- A solution is to augment human intelligence (in contrast to AI)

Main premise of network analysis:

Structure of links between nodes matters

- The properties and behaviour of a node cannot be analysed on the basis its own properties and behaviour alone.
- To understand the behaviour of one node, one must analyse the behaviour of nodes that may be several links apart in the network.
- Bottom up approach. Generalize and describe.
- Financial context: network of interconnected balance sheets
- Should we let the next Lehman fail?

New Paradigm



Visualizations:

Infographical **and** Analytical

- > Qualitative and Quantitative
- > Static Output and Explorable Interface
- > Cross-referenced reading - Connected (networks)
- > Real time reading

Implications in representation
but also in institutional behaviour
(monitoring and policy making)

New Paradigm



In the face of the crisis, we felt abandoned by conventional tools.

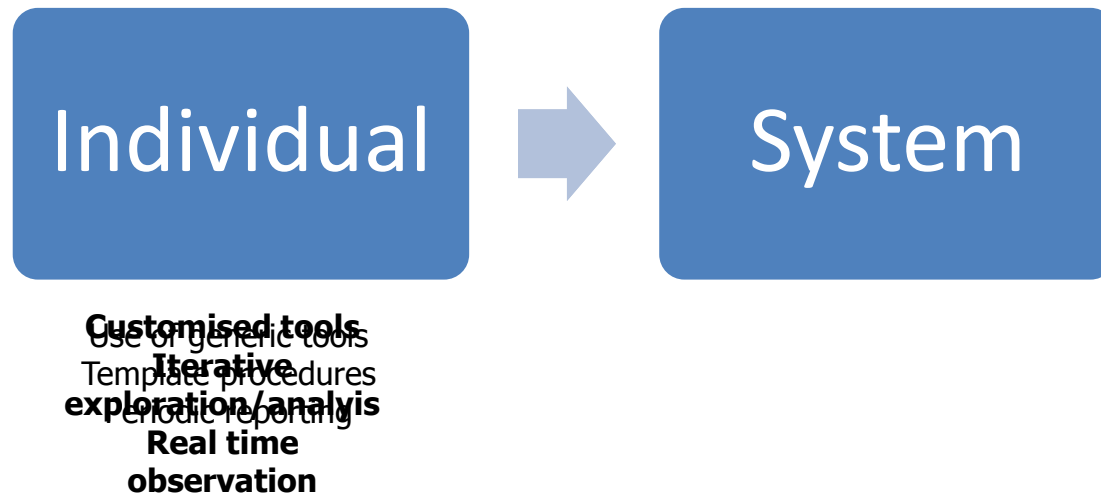
In the absence of clear guidance from existing analytical frameworks, policy-makers had to place particular reliance on our experience. Judgement and experience inevitably played a key role.

Jean-Claude Trichet, President of the ECB,
Opening address at the ECB Central Banking Conference,
Frankfurt, 18 November 2010

New Paradigm



MONITORING



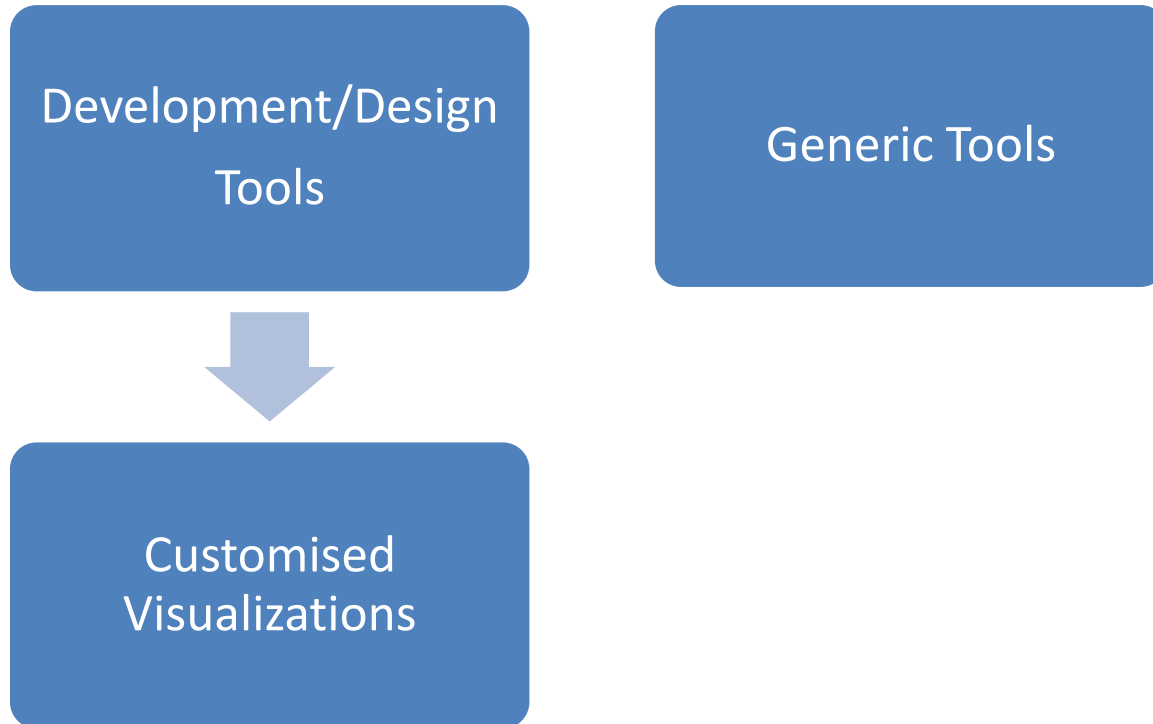
New Paradigm



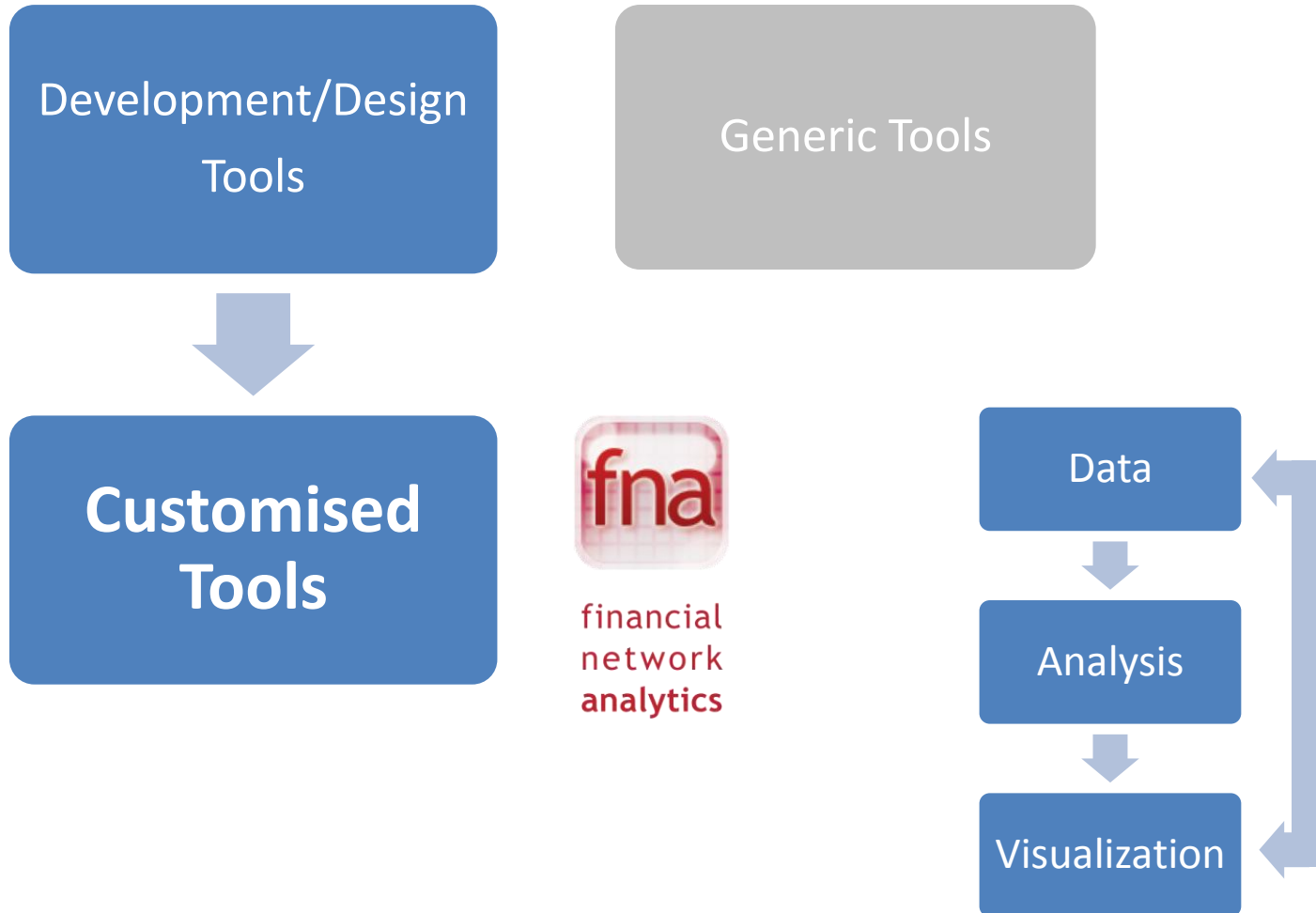
POLICY MAKING AND REGULATION

Information/Data
Driven
(Active)

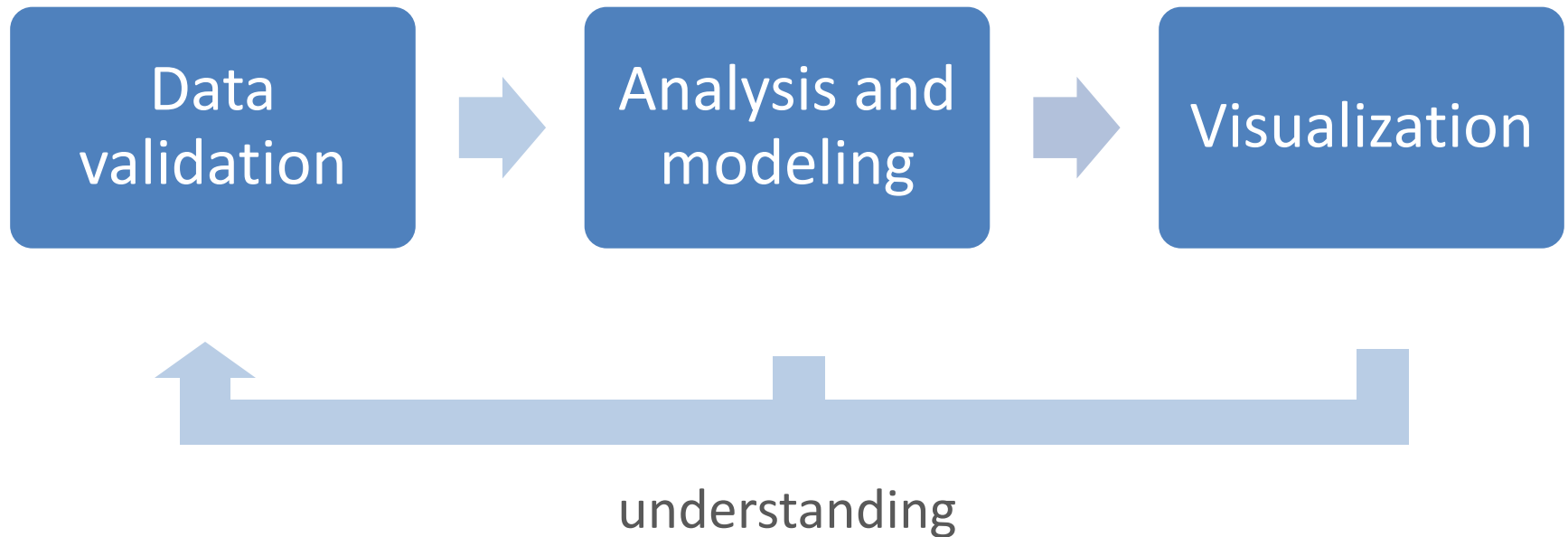
New Paradigm



New Paradigm



New Paradigm



New Paradigm



Visualization

(Namely In a complexity science context) visualization is

Evidence

Validation

Model Output

Springboard for Inquiry (feeding further analysis)

Implementation



- Objective 1: provide a tool for **exploration, analysis and visualization** of regulatory financial data
- Objective 2: Provide a extendible platform for **custom functionality**, and **agent based** and **simulation models**
- Objective 3: Make advances in **research** available **to policy**

Roots of the work



- Bof-PSS2
 - Bank of Finland, 1997-
 - Payment system simulator used in ~60 central banks
- Loki
 - NISAC at Sandia National Laboratories, 2004-
 - Toolkit for network analysis and ABM
- FNA
 - December 2009 -
 - Sponsored by Norges Bank, collaborative efforts with other central banks

The platform



Base

High-performance
graph model,
integration to
corporate IT

Intuitive to use,
flexible GUI,
dashboard

Modules

Models for financial
stability, (agent-
based) simulation,
visualization, ...

Can be developed
by third parties,
saves development
time

Network

Same tool is shared
among several
regulators leads to
robust models

Knowledge transfer
over organizations
and time

Current modules



NET – Network analysis, network metrics,
Network operations

VIZ-HIGHCHARTS – Common chart visualizations

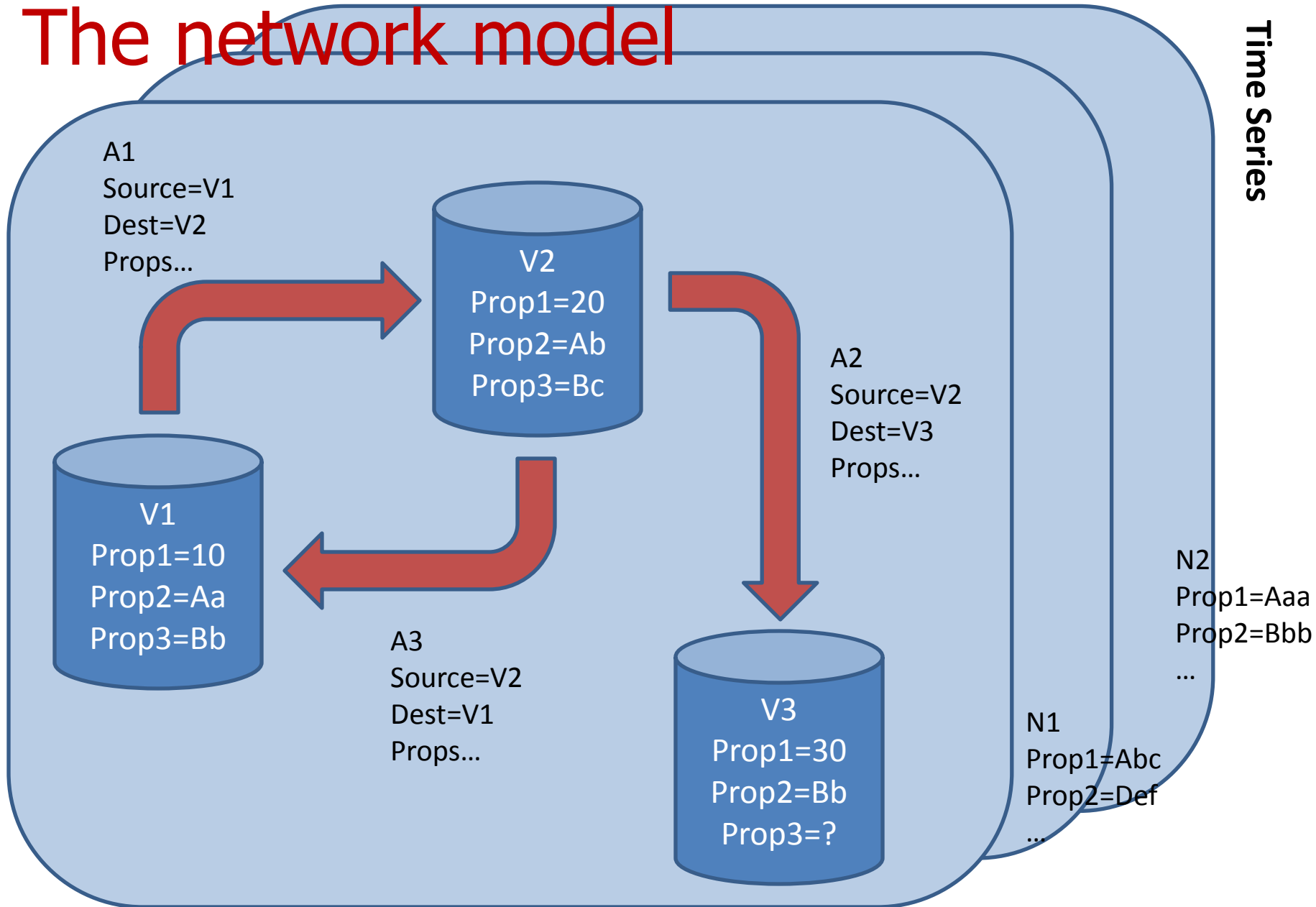
VIZ-PROTIVIS – Interactive network visualizations

DATA – Tools for working with large CSV files

MATCH – Algorithm for identifying overnight
loans from payment data

FLOW – Interbank payment system simulator

The network model



Screen

Access via browser
in intranet,
or desktop

Result panel shows
command output

Files and database
connections are in
file panels

(charts, data, etc)

'Visualize' screen
shows created
charts and layouts

Operation based
on commands

Each command has
different
parameters

Submit commands
(only one running
at a time)



Select Group

Create

Calculate

List

Edit

Visualize

Export

Data

Flow

Match

Select scope

Network

Vertex

Arc

Select command

Add

Build by count

Build by time

Build by value

Builds networks by aggregating event data between vertices.

Input file*

Source column*

Value column*

Operation on weights

Number limit

Destination column*

Store arc weight as property

Decimal Separator

Keep existing networks

maplayout.txt 16:56

forcedg.txt 16:56

arclayout.txt 16:56

paymentsimulation.txt 16:56

match.txt 16:56

validate.txt 16:56

extractfilelist.txt 16:56

extractfile.txt 16:56

enumerate.txt 16:56

crosscheck.txt 16:56

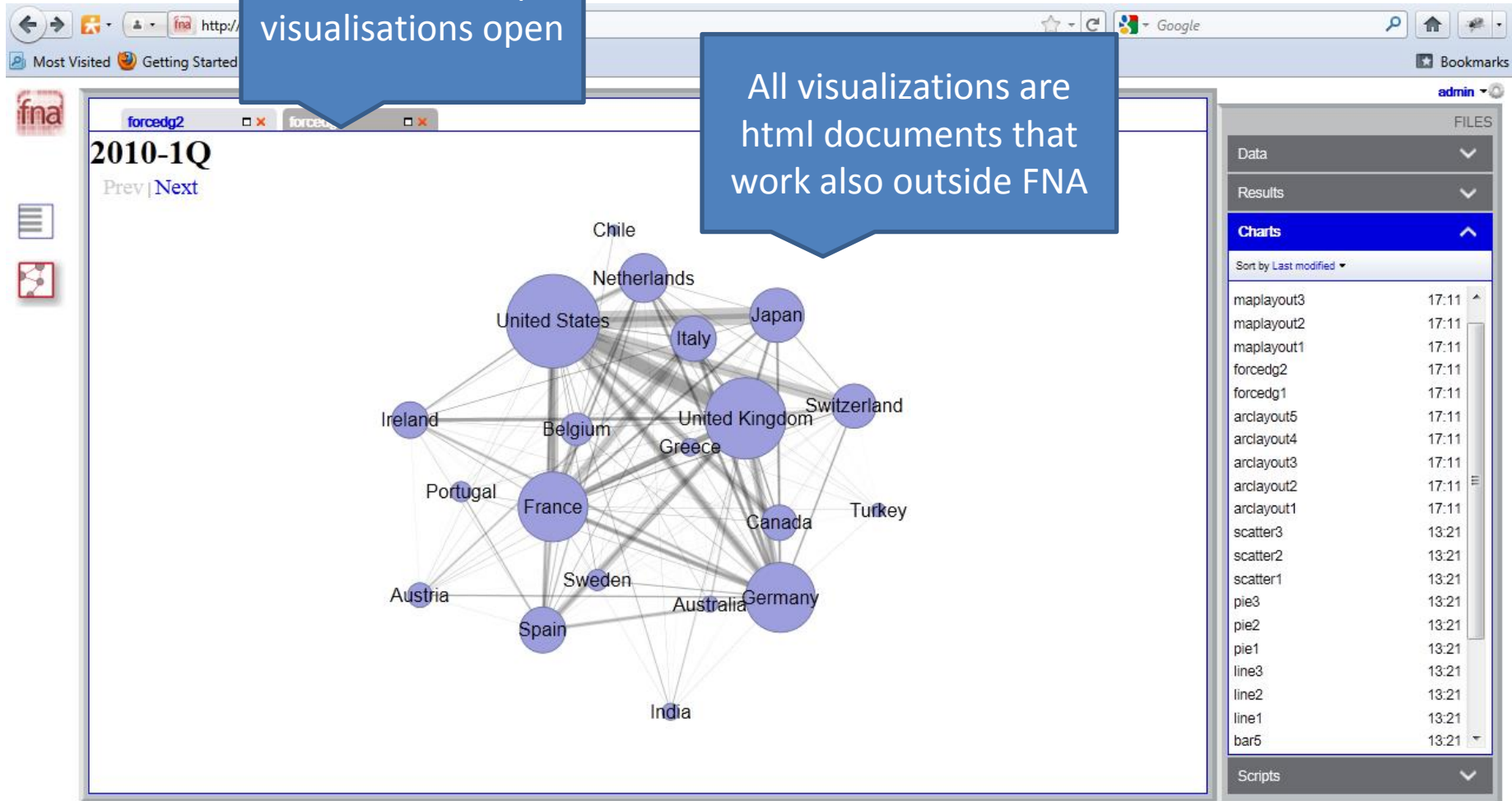
anonymize.txt 16:56

_mod-net-scripts.txt 16:56

transpose1.txt 16:56

Tabs allow multiple visualisations open

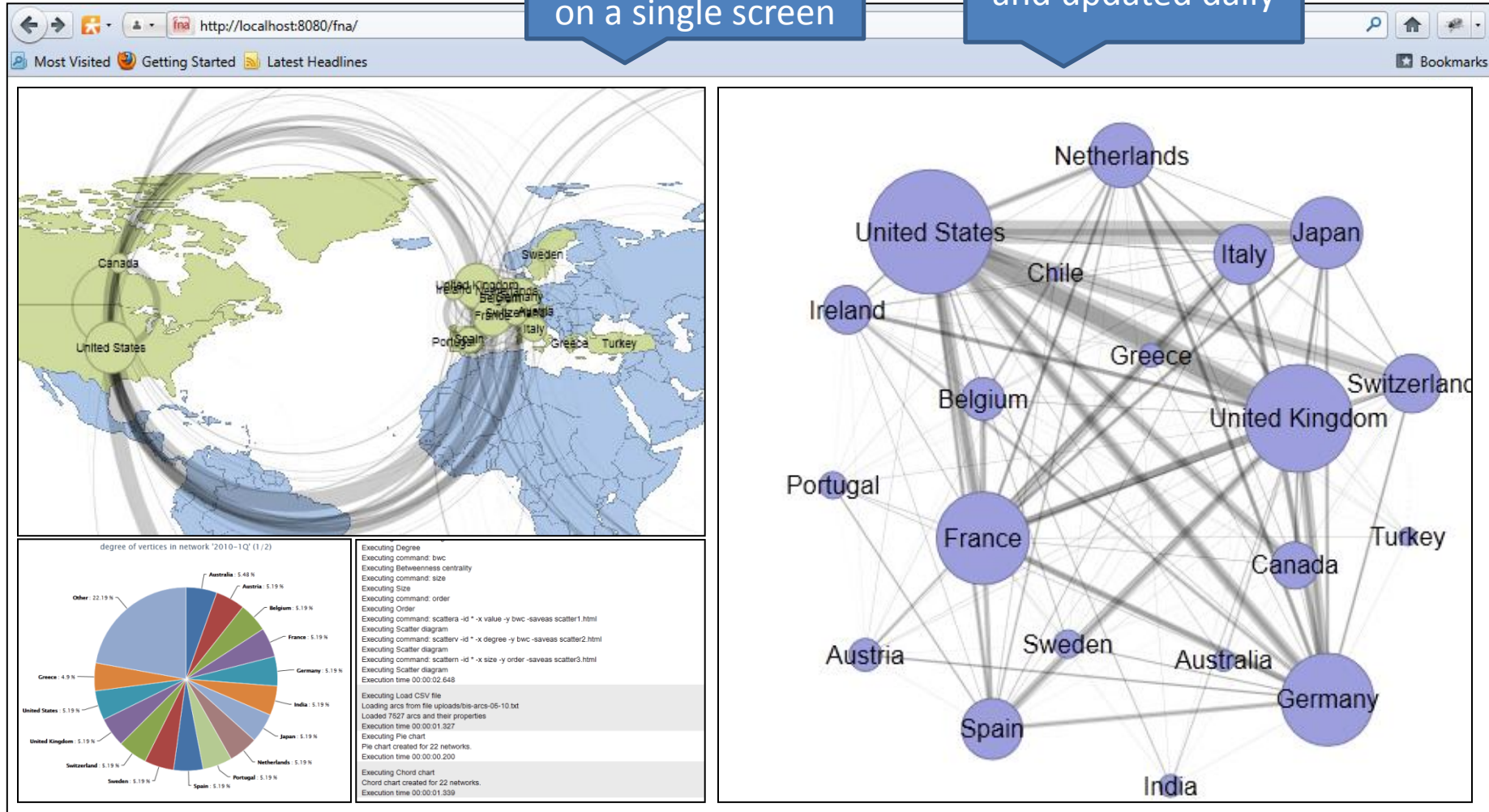
All visualizations are html documents that work also outside FNA



Dashboard (

The dashboard can combine multiple views to the data on a single screen

It can be available e.g. on the intranet and updated daily



Command line

Add new script file Maximize

File name:

new_script.txt

[Change order of lines](#)

```
loada -file uploads/bis-arcs-05-10.txt [delimiter=comma]
degree
pagerank -weight value
forcedg -a value -v pagerank
```

History provides an easy way to make new scripts for research or for the dashboard

All commands submitted (also from point-and-click) are shown in history

Scripts can be run from the scripts panel or as regular jobs by the server

Executing Load CSV file
Loading arcs from file U
Loaded 7527 arcs and
Execution time 00:00:00

Executing Degree
Result saved as vertex
Execution time 00:00:00

forcedg -a value

forcedg -a value -v pagerank
pagerank -weight value
degree
loada -file uploads/bis

File Name	Time
txt	10:36
e.txt	10:36
filelist.txt	10:36
e.txt	10:36
ate.txt	10:36
ck.txt	10:36
ize.txt	10:36



DEMO

More information



www.fna.fi

Follow us

... or get posts by mail

My e-mail:

Contact us

kimmo@soramaki.net

ines@soramaki.net

Thank you!