Dynamic Complexity of Cooperation-Based Self-Organizing Commercial Networks in the First Global Age

DynCoopNet

"The Evolution of Cooperation and Trading" (TECT) Launch Conference, Budapest, Hungary, 4-7 July 2007

Project Leader
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Madrid, Spain

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Treaty of Rome, 1957

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Europe, 1870

Image provided by Waldo Tobler

Dynamic Complexity of Cooperation-Based Self-Organizing Commercial Networks in the First Global Age

- Introduction: Multi-disciplinary research on Cooperation & Trading
- Primary Assumptions
- Hypotheses
- History, GIScience, Mathematics
- Introducing the researchers

GIScientists, Historians, Mathematicians in the DynCoopNet Ship

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Primary Assumptions

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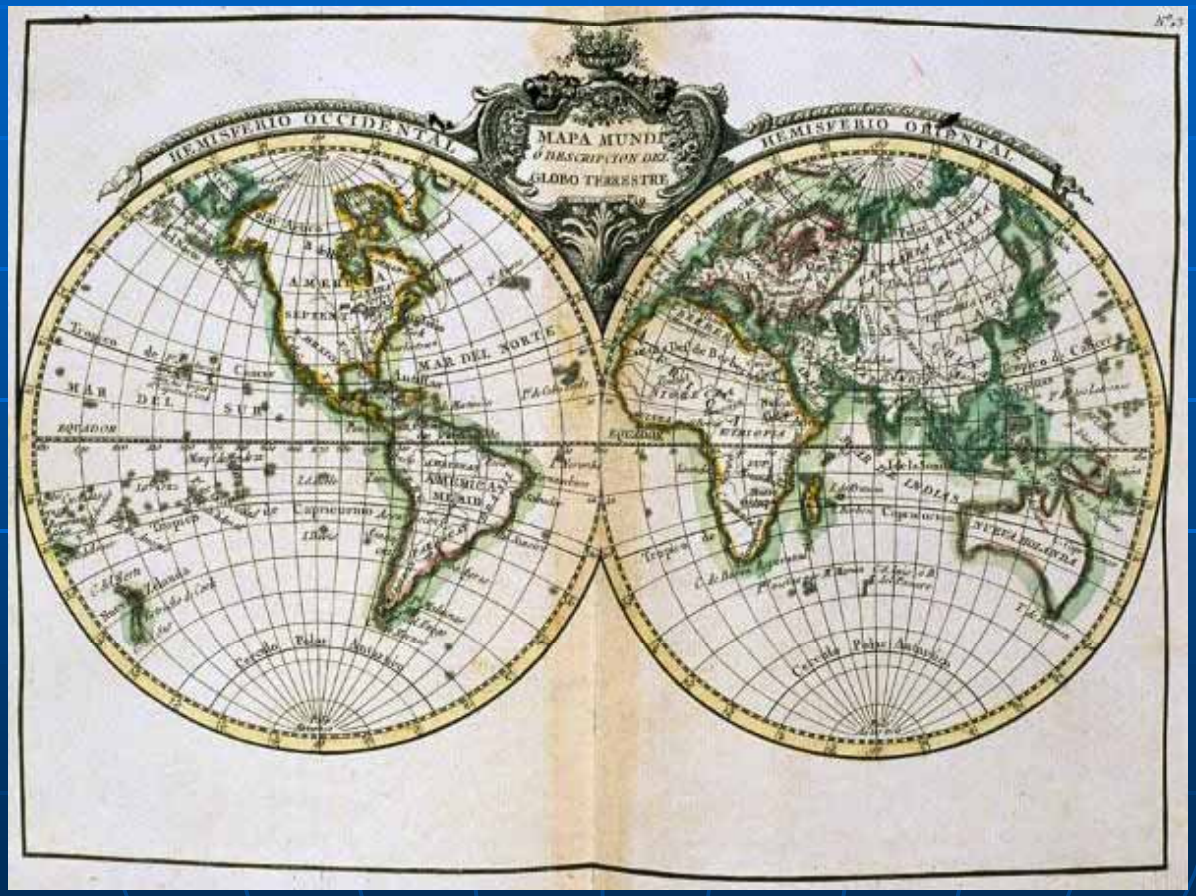
An Open, Dynamic, Complex, Nonlinear System?

Image provided by Waldo Tobler

Diverse Locations & Georeferenced Data

Image provided by Ana Crespo Solana



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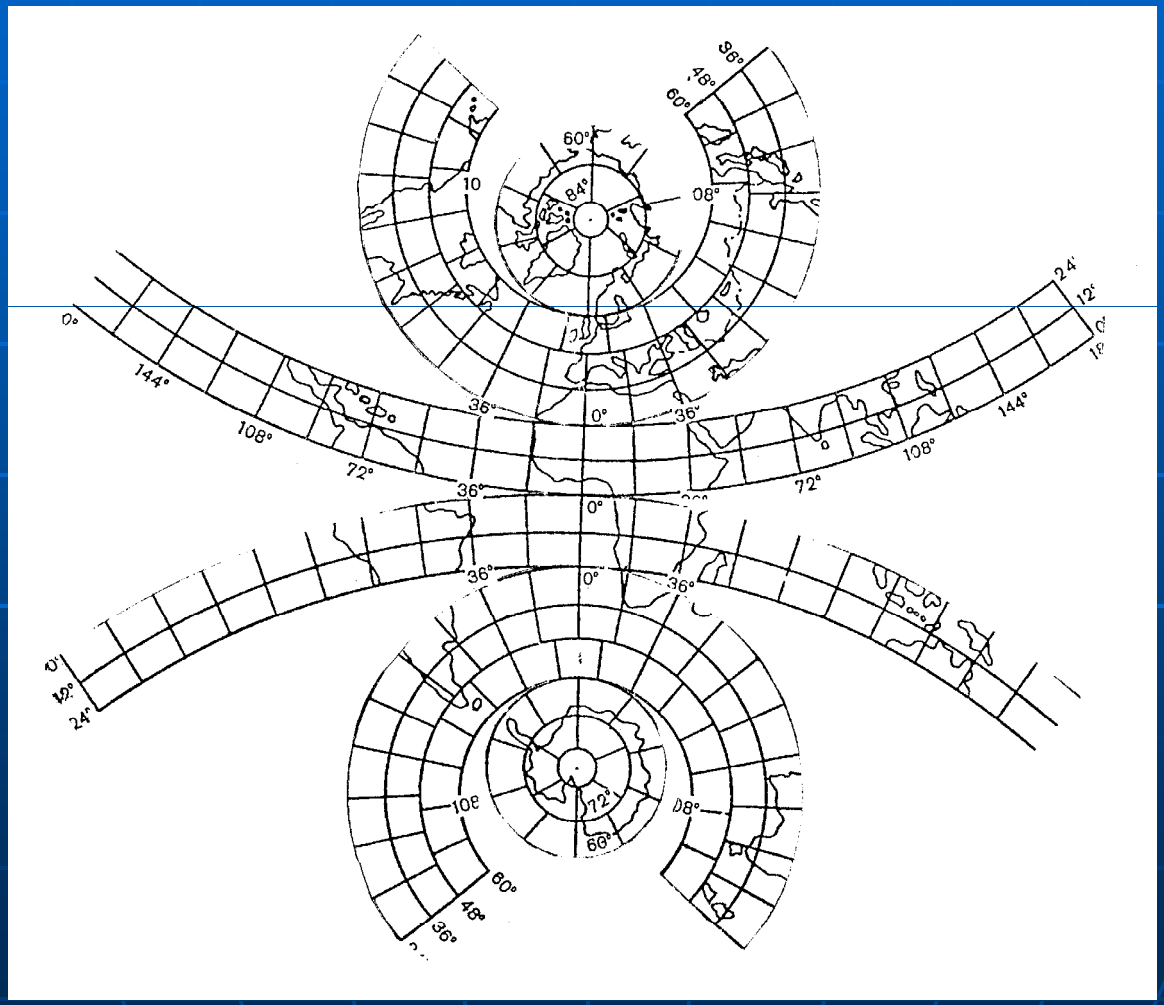
Connected World History

Image provided by Waldo Tobler



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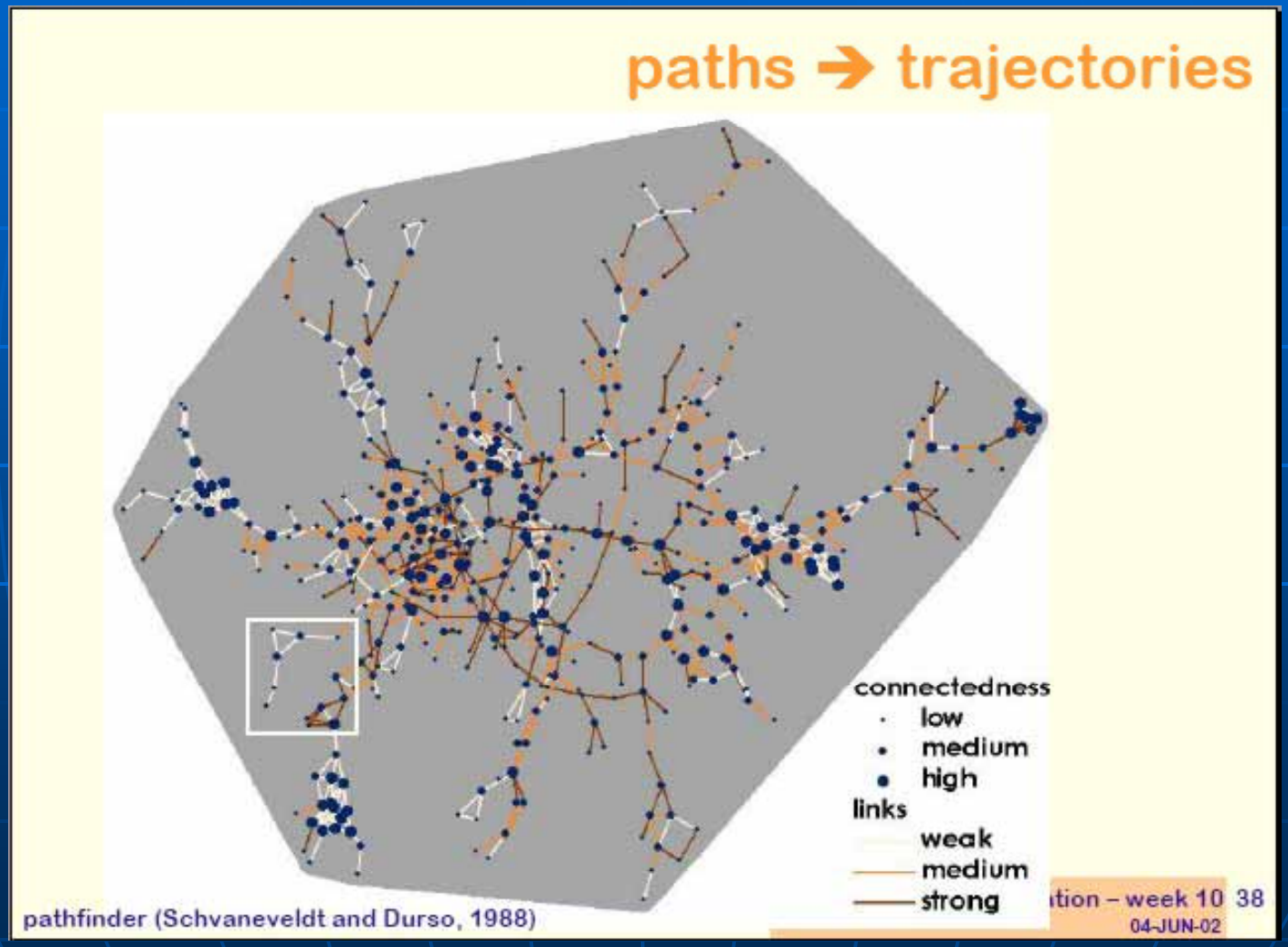
Cooperation & Self-organizing Commercial Networks

Image provided by sara fabrikant



Hypotheses

The State & Cooperation?

Cartagena de Indias

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Cooperation-based Networks & Creativity and Innovation

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Variations by Place

Fig. 228. Sklaventransport in Afrika.

Emergence of New Forms

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Multi-disciplinary Components

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Historians, Lots of Historians

Image provided by Hilario Casado Alonso

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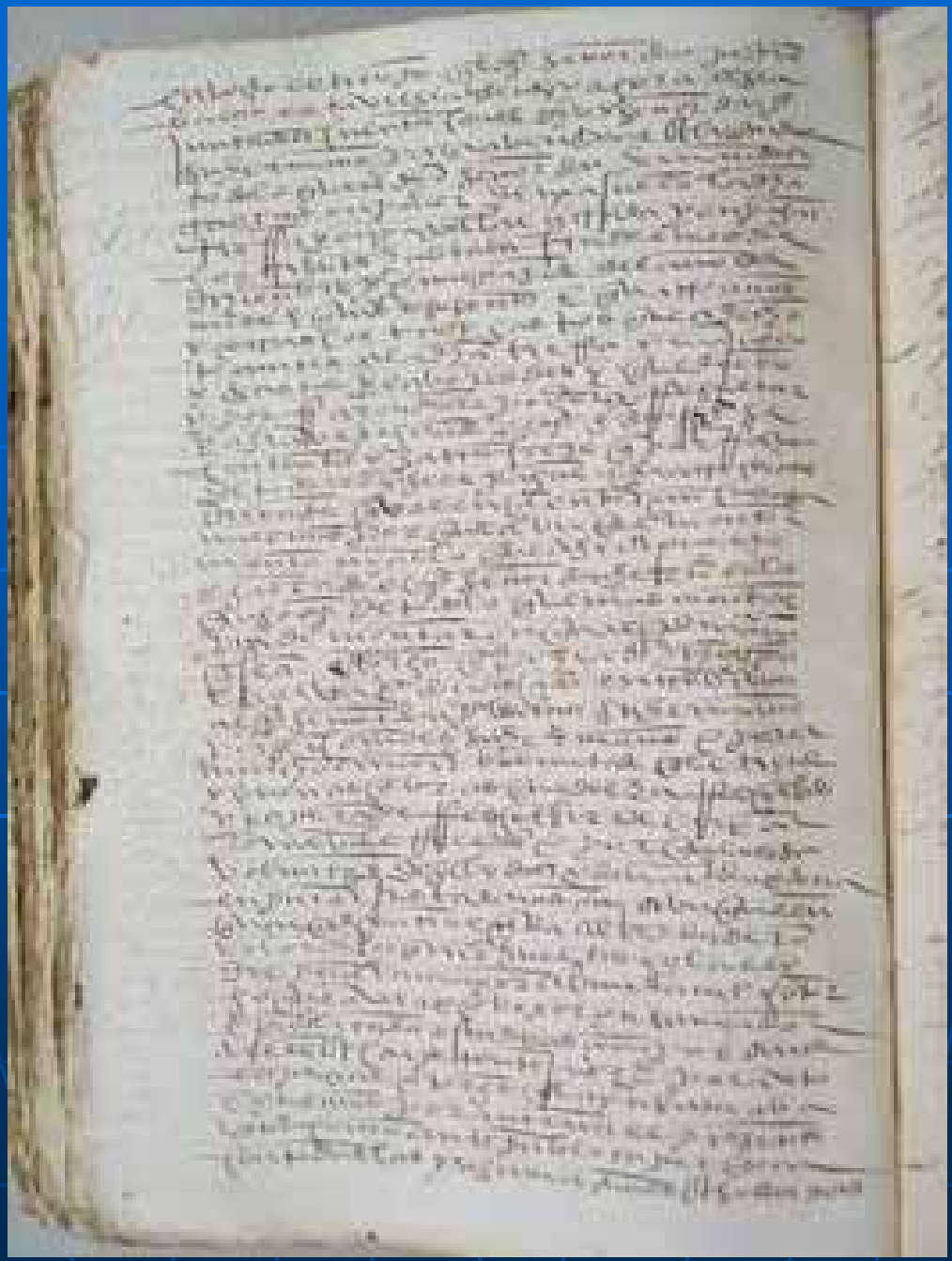
Data?

Image provided by J. B. Owens



Inter-University Consortium for Political and Social Research

ICPSR; www.icpsr.umich.edu/

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Master's Degree Program in Geographically-Integrated History

M.A. in Historical Resources Management

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Why focus on Iberian monarchies to study the world economy?

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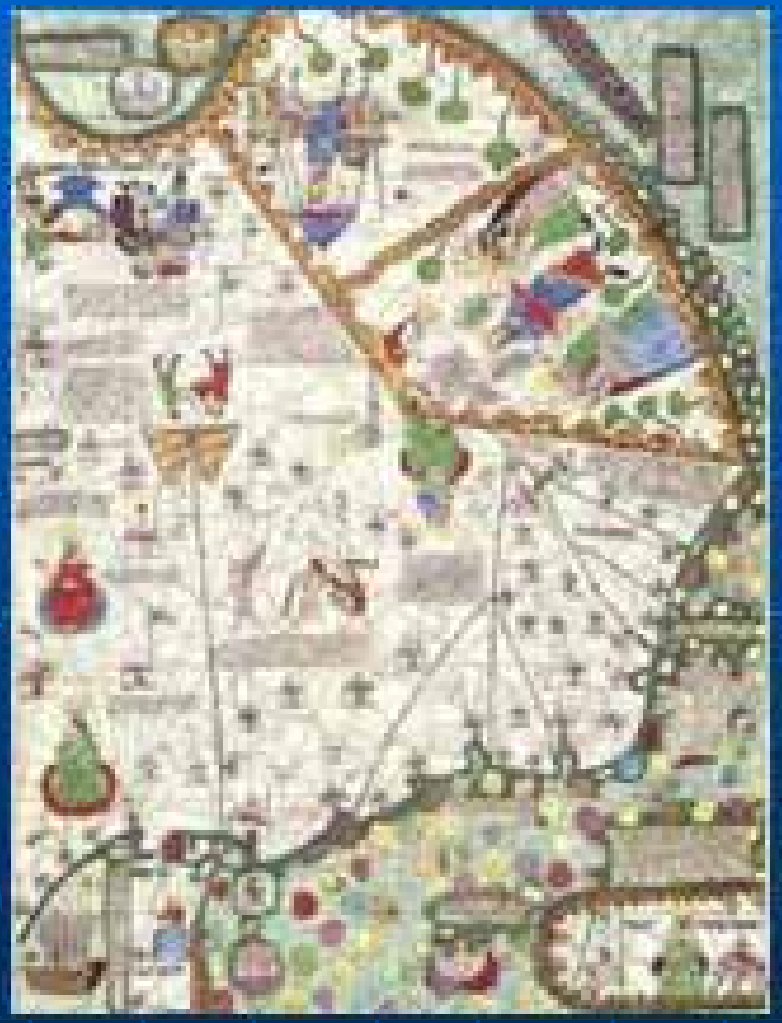
European Vision, 1502

Image provided by Waldo Tobler

China: Center of Afroeurasian Economy

Image provided by Antoni Picazo



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India, 1788

Image provided by Waldo Tobler

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Southeast Asia, 1684

Image provided by Antoni Picazo

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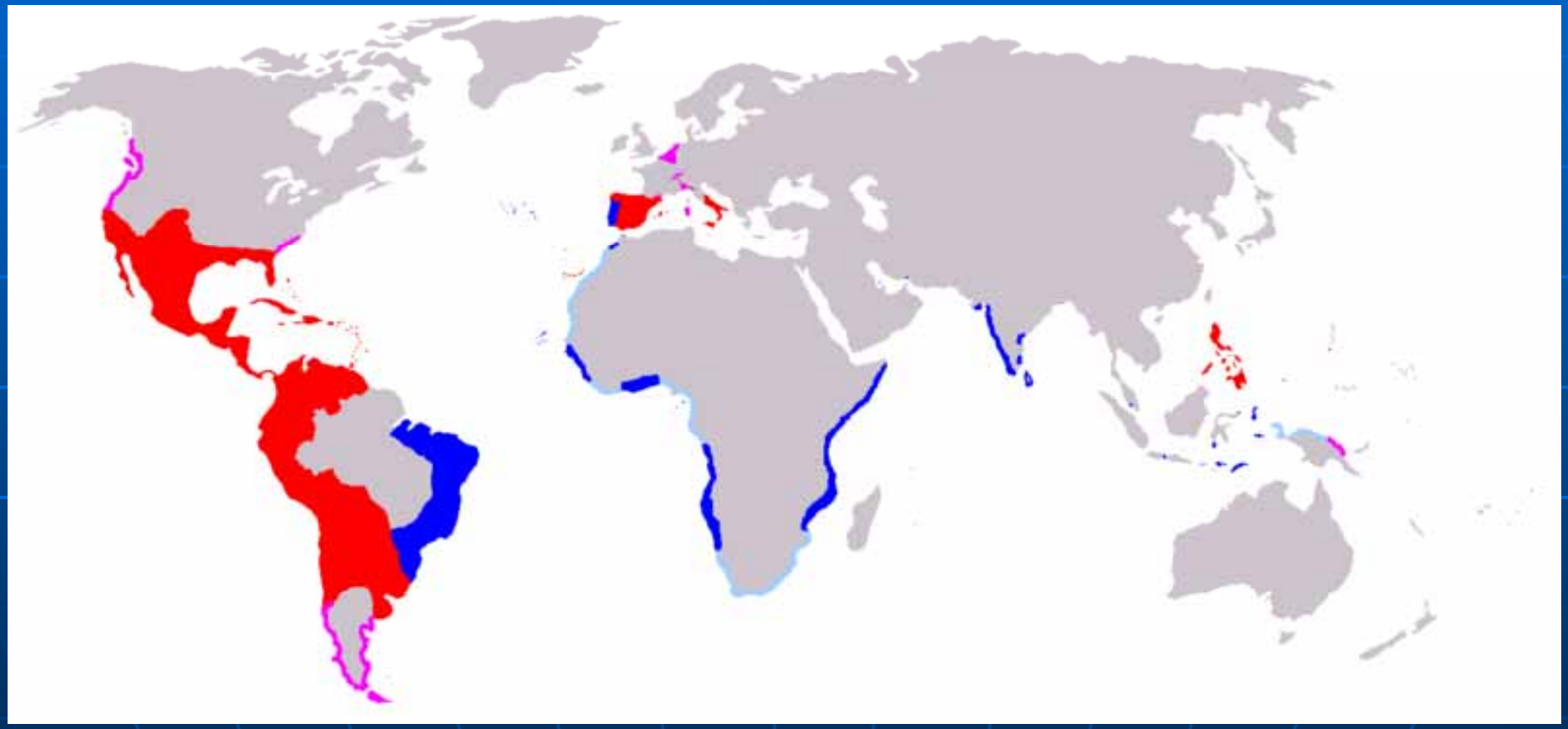
Global Hispanic Monarchy



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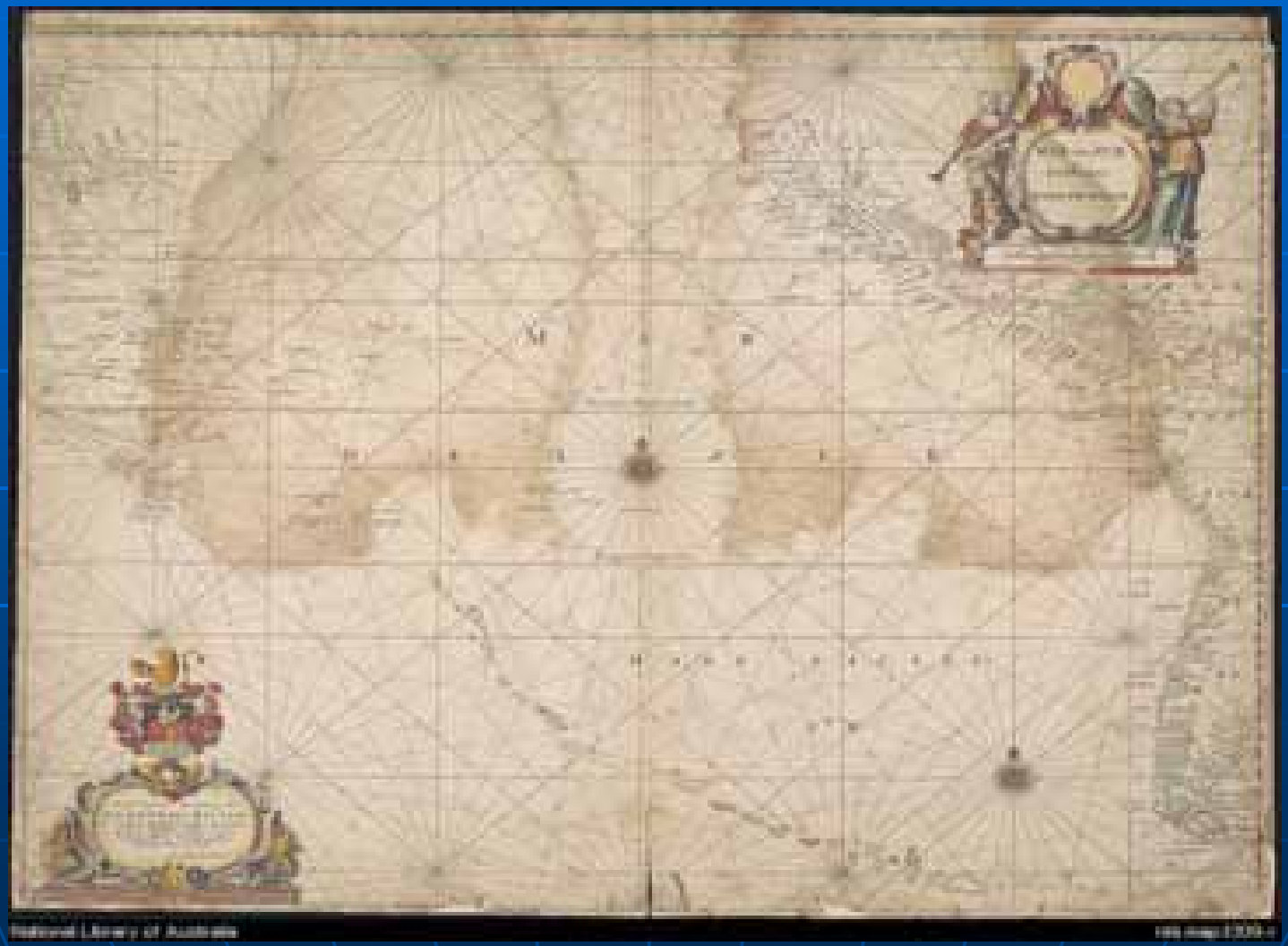
The Wide Pacific, 1658

Image provided by Antoni Picazo



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Sevilla

Lisboa

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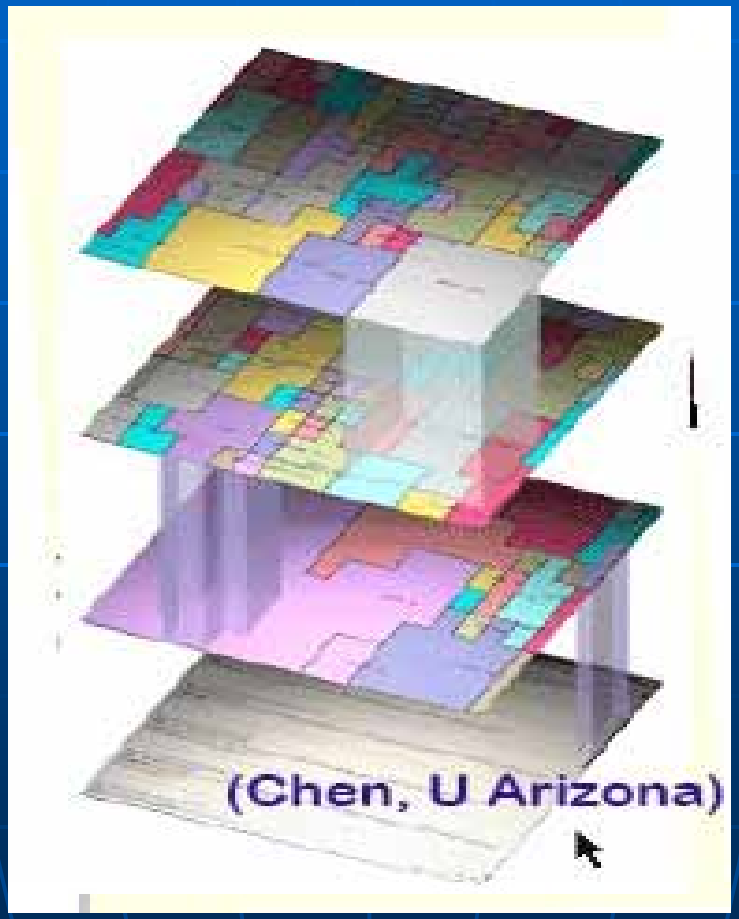
Geographic Information Systems (GIS)

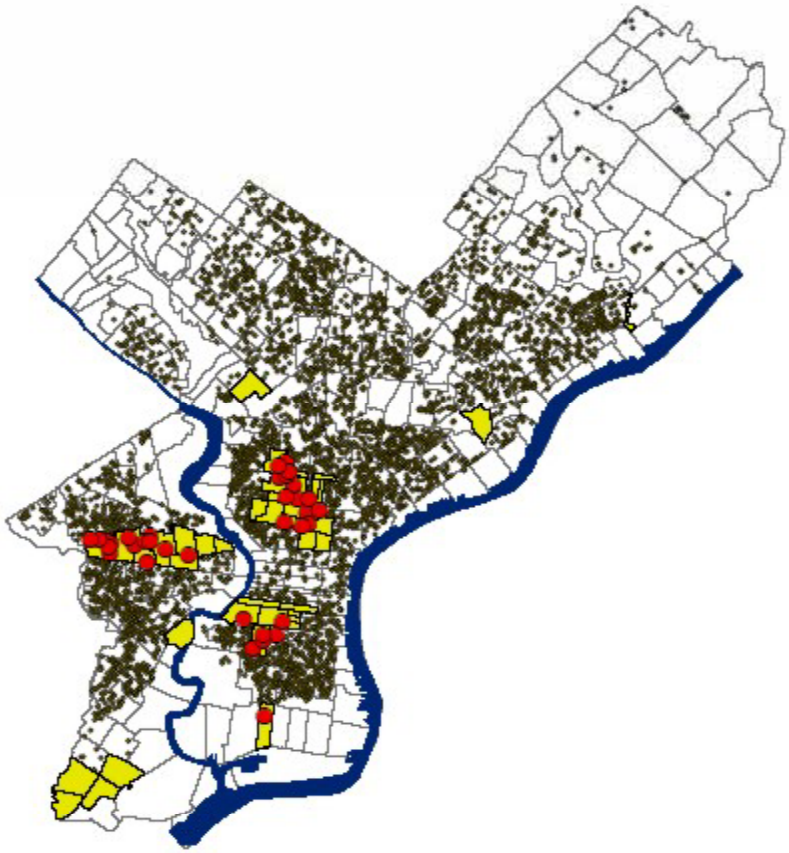
Image provided by sara fabrikant



Philadelphia Redlining, 1937

Amy Hillier (2004)

Figure 4: Query Results Showing 4.5 Percent Interest Mortgages (red dots) and Census Tracts with Majority Black Residents (yellow polygons)



Connection to the Internet

sara fabrikant (2002)

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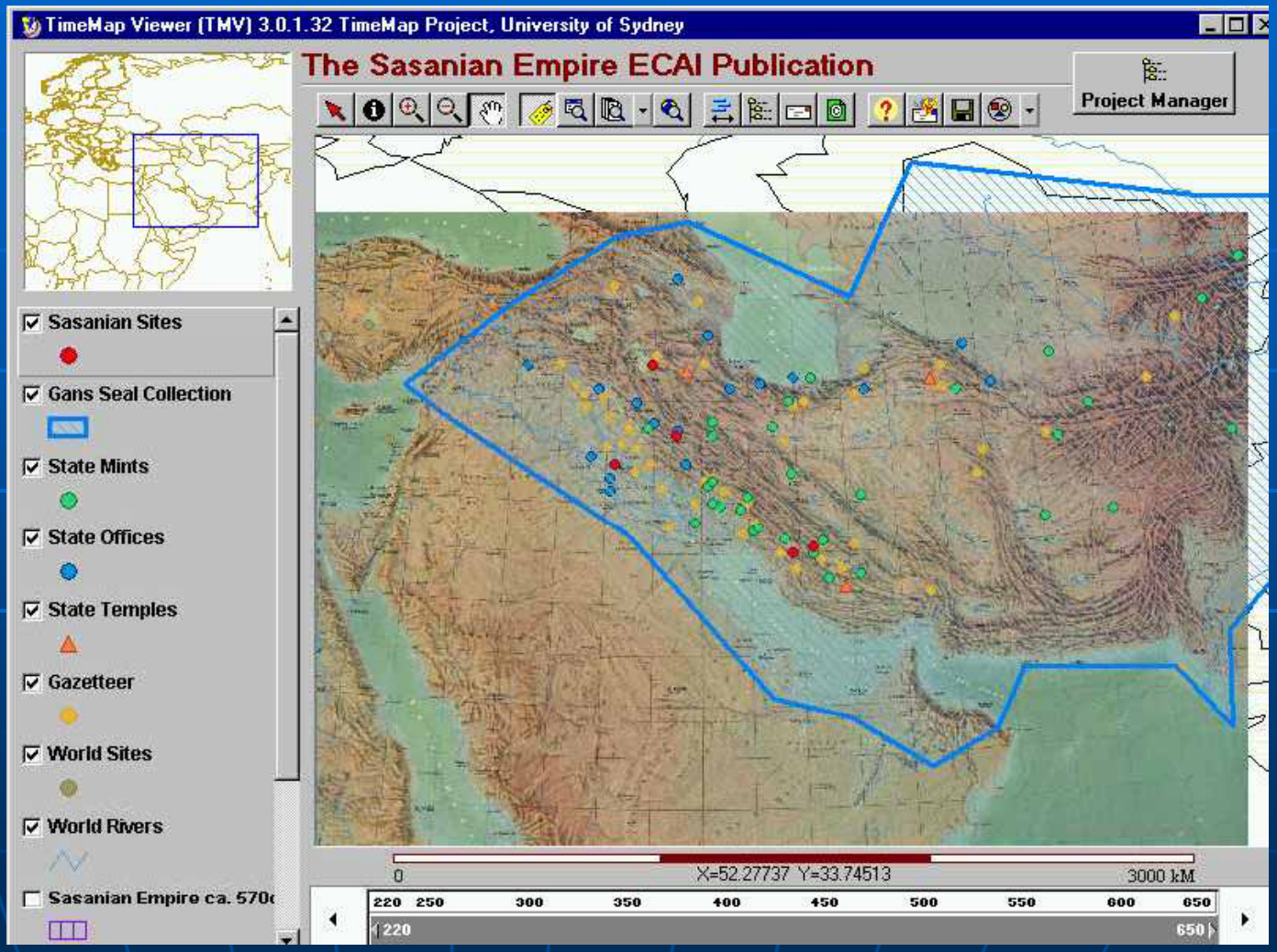
TimeMap (www.timemap.net)



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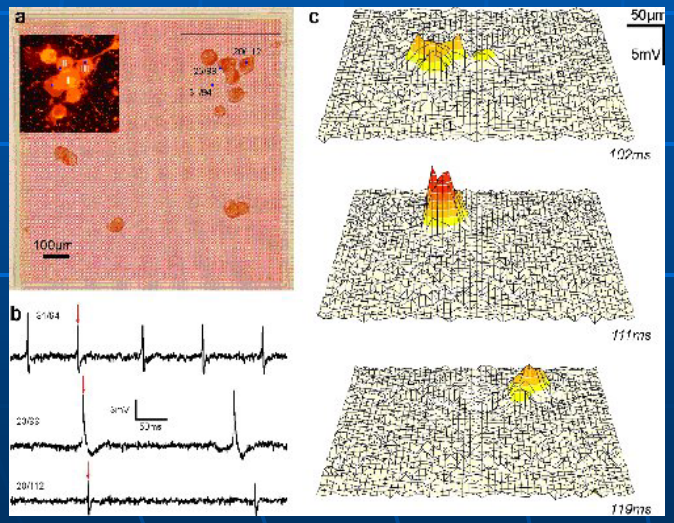
Develop a unified space-time representation for modelling cooperative interactions (behaviour), trade-flows, and network dynamics within an open-source GIS

- Given a **representation** of
  - Network dynamics
  - Trade flows
  - Cooperative interactions
- Model the **rules** governing change which account for the observed
  - Structures
  - Features
  - Patterns
  - Trends
  - Anomalies and
  - Relationships in data

DynCoopNet's Spatial-Temporal GIS
Cooperation, Trade Flows, Network Dynamics

- **How to represent the spatial dimension of cooperation over time?**
  - Dominant Space-Time Representation (current GIS)
    - Absolute view of space and time
    - Entities or events only exist when associated to a layer or theme
  - Relative Space-Time Representation
    - Relative view of space and time
    - May involve non-Euclidean space or non-linear time
    - Applied in studies of forms, patterns, functions, rates and diffusion

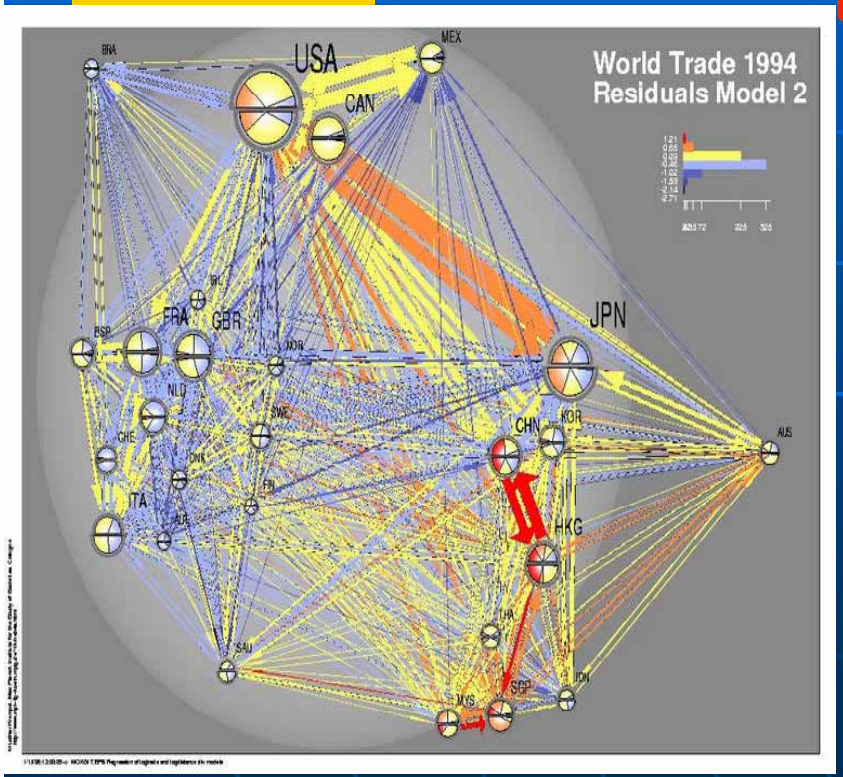
Cooperative Interactions



Trade Flows

- **How to represent the spatial dimension of trade flows over time?**

Trade Flows



- **Trajectory View** (current GIS)

  The flows are represented by a sequence of points over time, which can be stored as a tuple [x,y,z,t] in a GIS

- **Time Geography**

  The flows are represented as space-time fabric of individual life-lines (also known as paths, footprints) that are determined by natural laws and social conventions that partially constrain space-time behaviour.

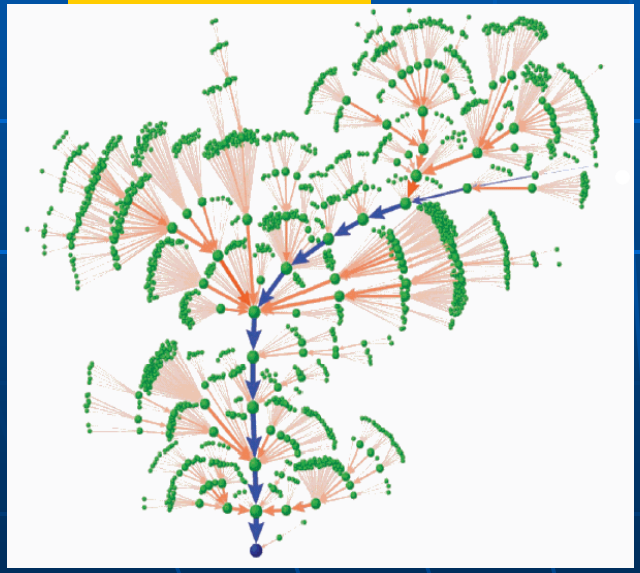
Network Dynamics

- **How to represent the spatial dimension of network dynamics over time?**
  - **Deductive reasoning approach** (current GIS)

    Based on mathematical representation of spatial entities and temporal events. These approaches are usually based on Euclidean space and/or on a topological description of space and time.
  - **Inductive Reasoning Approach**

    Based on observation and analysis of data. Among several spatial statistical methods that can be used to analyse behaviour and diffusion processes, such as point pattern analysis, spatial autocorrelation, weighted centographic analysis, spatial interaction and path analysis of individual routes.

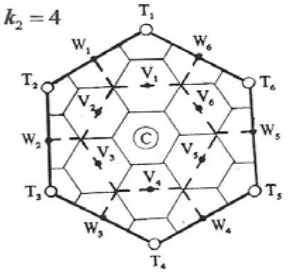
Network Dynamics



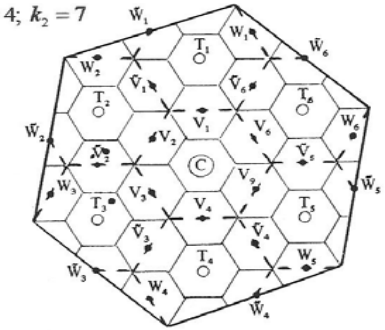
Mathematical Exploration & Modeling

Beckmann-McPherson Central Place Systems

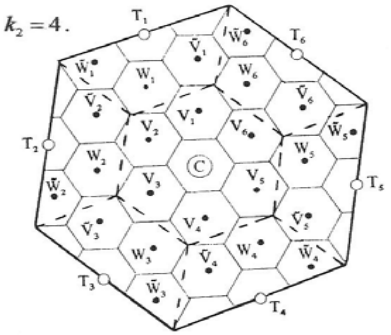
a). $k_1 = 3;\ k_2 = 4$



(b). $k_1 = 4;\ k_2 = 7$



(c). $k_1 = 7;\ k_2 = 4.$



Major Research Questions

1. **Did the spatial organization of the trading networks, the level of risk, the exercise of power or division of labor in more complex organizational schemes influence the patterns of cooperation among actors?**
2. **Within their social and cultural environments, how did merchants maintain "creditworthiness" (reputation, trust), and was reputation really necessary for such a remarkable degree of cooperation over often great distances and with people they sometimes did not know?**

- Were there brokers?
- How were the rules of the market sites and long-distance interactions set and maintained?
- How did information flow through commercial networks and of what kinds?
- Under what circumstances did cooperation in trading activity break down or fail to develop?
- What sorts of behavior undermined the "trust" among parties engaged in trading activity?

- Did new forms of communication in the first global age, particularly cartography and the printed book, contribute to the emergence of new forms of human cooperation?
- Did the emergence of cooperative commercial activity constitute a historical process that contributed to greater tolerance and conflict reduction in any part of the global economy?
- Did the patterns of cooperation characteristic of the behavior of some groups provide them with some comparative advantage? If so, in what circumstances?

- Was there something about cooperation in self-organizing networks that gave participants the energy, time, and knowledge necessary for innovation to gain a comparative advantage over groups and networks where cooperation was less frequent?
- What were the historical pathways by which within-group and between-group patterns of cooperation and trade emerged in the first global age?
- Were the places characterized by cooperation in trading activities also communities within which high levels of other forms of cooperation were evident (for example, social mechanisms reducing factional conflict, investment in common religious devotions, communal farming and herding)?

- **Did the cooperation characteristic of self-organizing commercial networks of the first global age emerge from behavior that had developed earlier for other reasons?**
- **Were the evolutionary processes of commercial cooperation in the first global age ones that can be linked to longer evolutionary-historical sequences, or was the first global age itself the product of some major systemic transformation (bifurcation)?**

Introductions

- Historians
- GIScientists
- Mathematicians

- **University of Porto**
  - **PI: Prof. Dr. Amélia Polónia da Silva**
  - **AP: Prof. Dr. Hilario Casado Alonso (University of Valladolid, Spain)**
  - **CP: Dr. Amândio Barros**

Simón Ruiz (1525-1597)

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In the Indian Ocean Basin and Pacific Oceania

Rila Mukherjee, Antoni Picazo, and Benigna Zimba

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Family Organization

Sara T. Nalle

John Simon Guggenheim Memorial Foundation Fellow, 2007-2008

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Castilian interactions with non-Castilian financiers and merchants in Castile and elsewhere

- David Alonso García
- Carlos Álvarez Nogal
- Hilario Casado Alonso
- Ana Crespo Solana
- Juan Gelabert González
- Vicente Montojo Montojo
- J. B. “Jack” Owens
- Antoni Picazo

GIScience & Historic Cartography

- Miguel Ángel Bernabé
- T. Matthew Ciolek
- J. B. “Jack” Owens
- Antoni Picazo
- Monica Wachowicz
- May Yuan
- with gvSIG & IVER (Open Source GIS)

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LatinGEO – Universidad Politécnica de Madrid
Grupo Mercator

- Miguel Ángel Bernabé
- Daniel Orellana
- Monica Wachowicz

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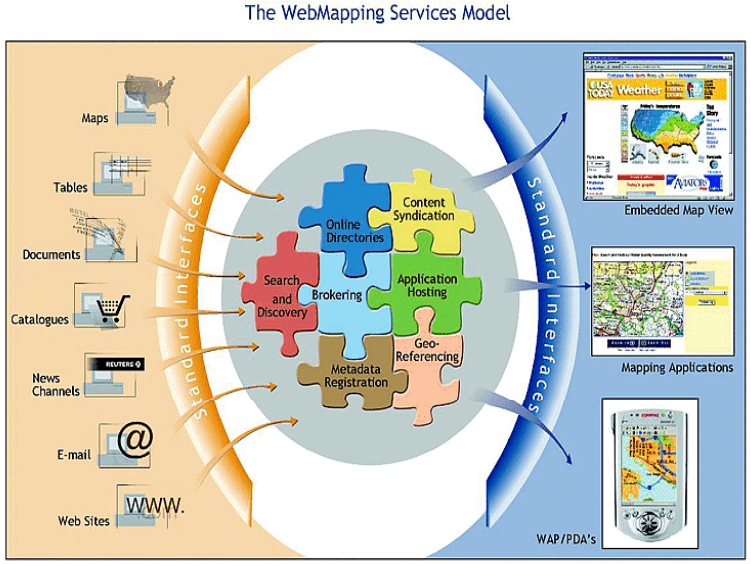
DynCoopNet Web Services

Design and implement the required web services of a Spatial Data Infrastructure (ChronoPortal) for dynamic on-line visualisation and query handling.



Five services could be created according to ISO 19115

- **Web Metadata** Services
- **Web Map Services** (raster)
- **Web Feature Services** (vector)
- **Web Coverage Service** (satellite images, photographs)
- **Web Catalogue Service**
- **Web Gazetteer Service**

Mathematicians

- Emery A. Coppola, Jr. Noah L.L.C.
- Tönu Puu CERUM (Centre for Regional Science), Umeå University
- Michael Sonis Bar Ilan University
- Shahriar Yousefi Centre for Advanced Research in Nature and Society

Routes of Communication & Collaboration

- T. Matthew Ciolek
- Ana Crespo Solana
- J. B. “Jack” Owens

The End?

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