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Application of Information and Communication Technologies for Historical Research

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10-14 September, 2014
ITU - ISTANBUL

APPLICATION OF INFORMATION AND COMMUNICATION TECHNOLOGIES FOR HISTORICAL RESEARCH

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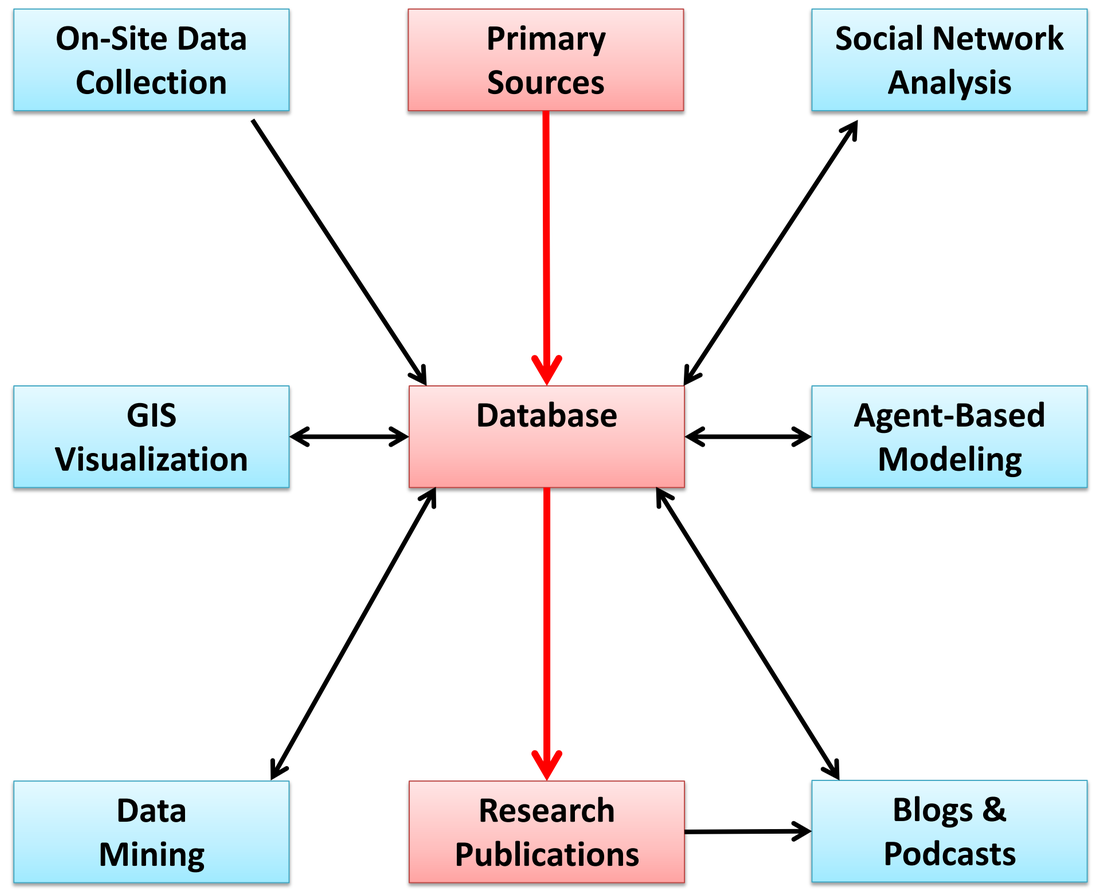
T02S002

Continuing advances in information and communication related technologies are providing new ways to augment historical research:

- ***On-site data collection*** using mobile devices (e.g. iPhone) enables real-time collection of and access to field data.
- ***Geographic information systems*** (GIS) allow access to and visualization of georeferenced data.
- ***Social network analysis*** and ***agent-based modelling*** allow data to be used to drive models of human behaviour.
- ***Blogs***, ***podcasts***, and related social media allow crowd-sourced research and almost-real-time communication of research findings.
- ***Data mining*** can be applied to detect hidden patterns and structure found in the "big data" generated by the preceding technologies.

Application of these technologies as an ***integrated set*** enables:

- Collaborative generation and analysis of massive databases of archaeological information to leverage scarce human, material, and financial resources;
- Data-driven development and verification of theoretical models of human behaviour to augment orthodox research methodology.



On-Site Data Collection and Geographic Information Systems (GIS)

Example

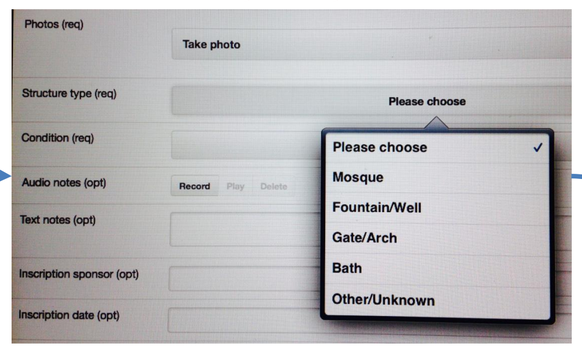
Ottoman Inscription Archive : On-site crowdsourced on-line digital archive of Ottoman dedication inscriptions.

- Information collected on-site using mobile device e.g. iPhone using GISCloud mobile app (GISCloud.com).
- Information stored in cloud in OIA database.
- Information immediately available to all collectors on map display.
- Translator translates inscription offline and updates database for that inscription.
- Inscription experts analyze all inscriptions and associated information in database.

Crowd-sourcing of information enables accumulation of massive inscription database.

See:
www.technologyforge.net/OIA/OIACaseStudy.htm

Collector enters info into form on mobile device



Translator translates inscription and updates database

IIC Database
- Sponsor: …
- Date: …
- Photo: …
- ***Translation: ……***

Collector views info on mobile device

Inscription expert analyzes inscriptions in database

Data Mining

Data mining technologies provide general tools that can be used for analyzing historical sites according to characteristics (attributes) recorded in site databases*:

Clustering - Grouping of objects by characteristics where there exist ***no previously known*** associations among objects. Example: associating archaeological artifacts with sites based on location and artifact attributes such as artifact type and artifact material.

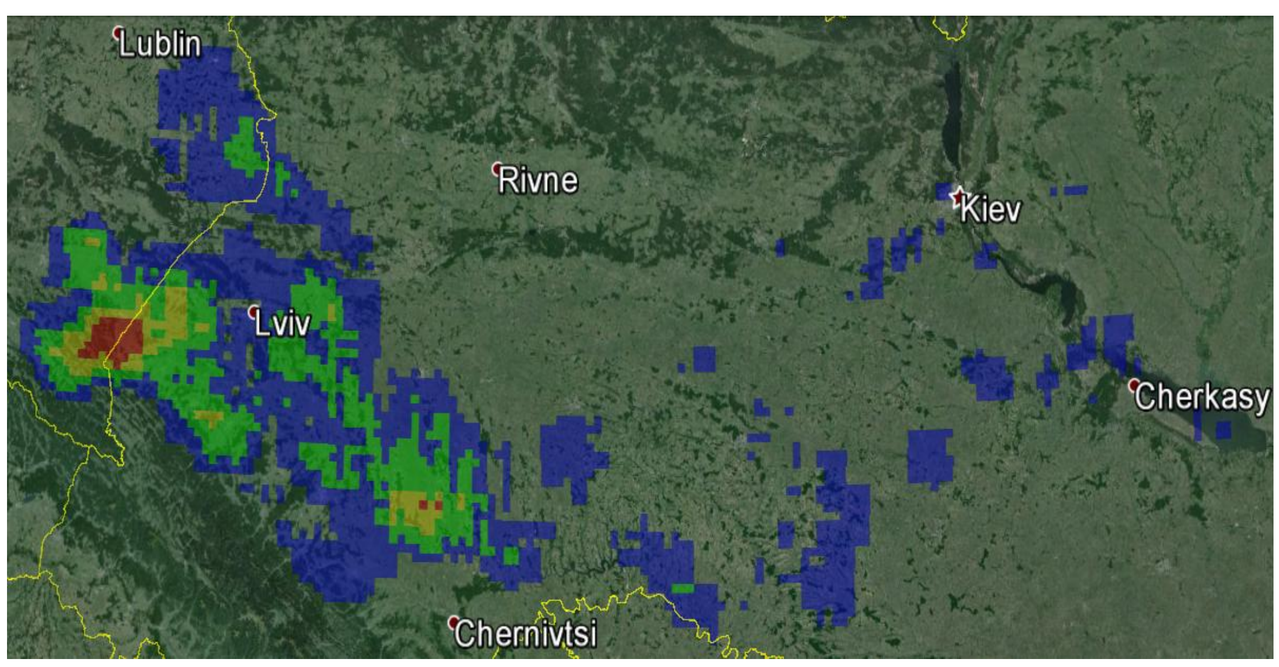
Classification - Grouping of objects into classes given ***previously known*** class attribute/class rules. Example: If artifact is a bone utensil located within 20 meters of dwelling site located at (x,y) , then the artifact came from that dwelling.

Association - Grouping of objects that naturally "go together". Example: Pottery with low aggregate concentrations tend to have black-on-white glazing.

Example:

Defensive networks along Polish-Lithuanian Commonwealth / Ottoman Empire frontier.

- *Defensive site*: Any area of habitation capable of resisting attack.
- *Defensive potential*: Capacity of the site to resist attack. Depends on factors such as –
  - geographical proximity to other sites;
  - terrain in the vicinity of the site;
  - site construction.
- *Defensive network*: Geographical cluster of sites with high defensive potential.



Heat map showing frontier defensive networks:

- "Heat" of an area depends on ***density of sites*** in area and ***defensive potential of each site.***
- Red areas represent highest concentrations of sites with highest defensive potential.
- Heat map created using grid-based clustering algorithm.

* Databases for data mining may be created using ***on-site data collection and GIS technologies***.

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Social Network Analysis

Social network analysis focuses on ties among social entities such as people, groups of people, organizations, and polities. Analysis focuses on factors such as:

Cohesion – Which entities share ties, and which do not? Why do they share ties, and why not?

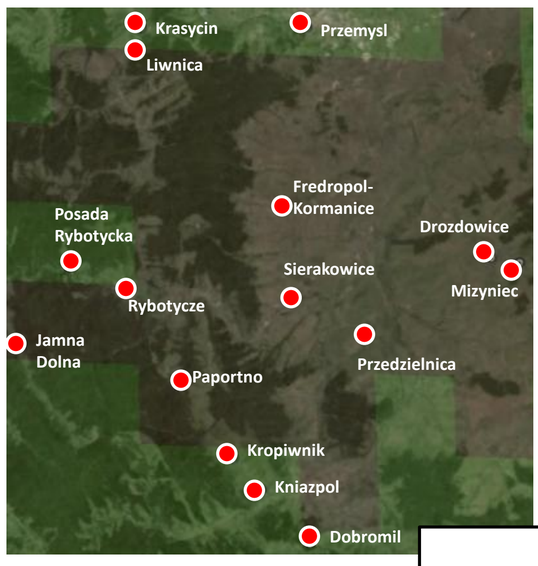
Brokerage - How are goods, services, ideas, etc. transported among entities that share ties?

Ranking – Which are the most and least prestigious entities in a network?

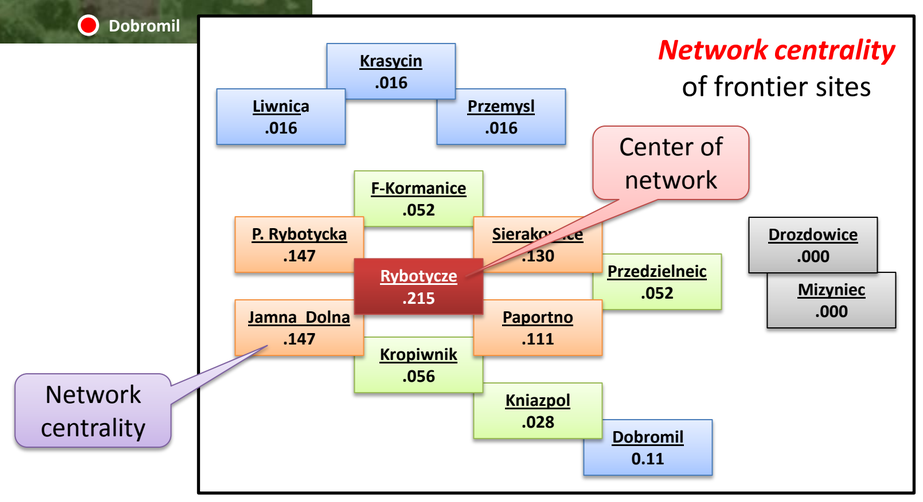
Roles – What roles do each of the entities in a network play? Superior? Mediator? Minion?

Example:
Centrality of sites along the Polish-Lithuanian Commonwealth / Ottoman Empire frontier.

- ***Geographical centrality*** depends on geographical proximity of sites.
- ***"Heat"*** of a geographical area (per defensive network data mining example) depends on:
  - ***Density*** of sites;
  - ***Defensive potential*** of each site in the area.
- ***Network centrality*** for this example depends on:
  - ***Number of ties*** to other sites;
  - ***Importance of the sites*** that a site is linked to.
  - ***Ties*** between sites can consist of treaties, family relationships, etc.



Geographical distribution of sites within a defensive network along the Polish-Lithuanian Commonwealth / Ottoman Empire frontier.



Network centrality of frontier sites

Agent-Based Modelling

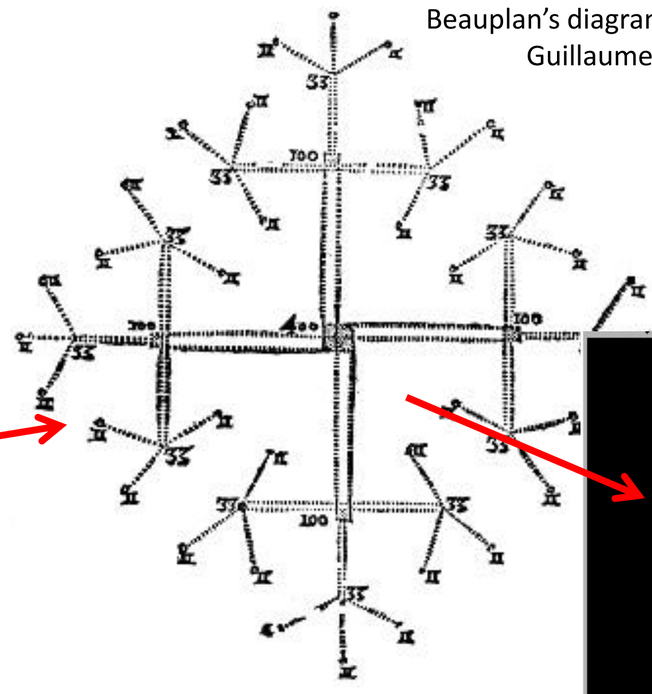
Agent-based models can be used to generate or verify macro-level theories of actions and behaviors based on the micro-level actions and behaviors of individual "agents". Though highly synthetic, such models can be useful for revealing patterns and relationships hidden within masses of text-based source data.

Example:
Visualizations of historical Crimean Tatar slave raids in southern Poland-Lithuania.

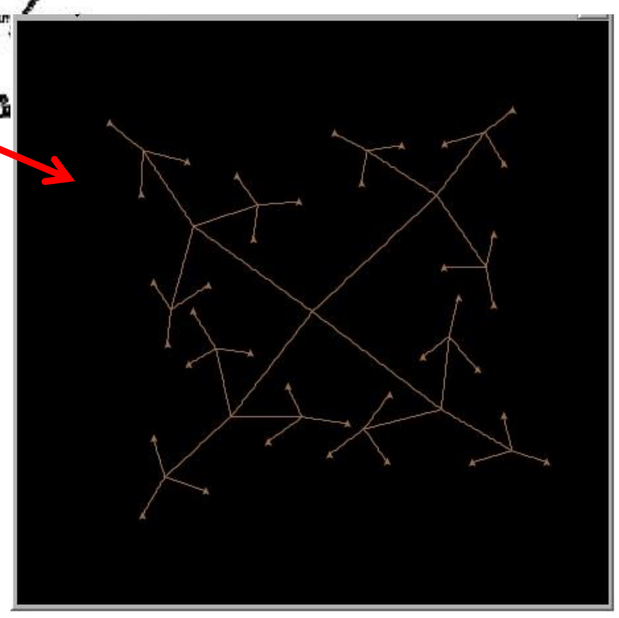
- During the early modern period, 2 million slaves were taken in Tatar slave raids.
- Combining primary sources describing methods used during slave raids with detailed accounts of specific forays and period geographical terrain maps, dynamic visualizations can be created to provide insights into depopulation patterns caused by slave raiding.

Beauplan's description of Tatar slave raid dispersal tactics:

1. Unit of about 400 Tatar raiders divides into four parts of about 100.
2. Each part moves about 1 ½ leagues in one of four directions.
3. Each part of divides into 3 parts of about 33.
4. Each part moves about ½ league in one of three directions
5. Each part divides into 3 parts of about 11.
6. Each part moves about ½ leagues in one of three directions.



Beauplan's diagram of slave raid dispersal tactics.
Guillaume Le Vasseur, Sieur de Beauplan,
A Description of the Ukraine.



NetLogo agent-based model of Beuplan's description projected onto terrain map of region in Ukraine.

Blogs and Podcasts

Blog (*web log*): Discussion or informational site published on the World Wide Web consisting of discrete entries (*posts*).

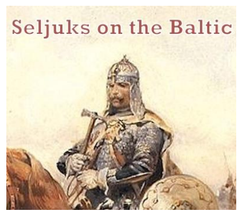
- Posts often written by large numbers of authors .
- Enabled by advent of web publishing tools that facilitate posting of content by non-technical users.
- In contrast with static websites, blogs are often interactive, allowing visitors to add to contents.
- Interactivity builds social and professional networks among blog participants.

Podcast (netcast): Audio or video program made available in digital format for automatic download over the Internet.

Blogs, podcasts, and related social media (e.g. Facebook) allow crowdsourced research and almost-real-time communication of research findings.

Example of ***blog*** hosted by Michael Polczynski

Created using "Blogger" blog publishing tool.



Recent
Polonia Ottomanica
blog postings

Example of ***podcast*** hosted by:

- Michael Polczynski
- Chris Gratien
- Paulina Dominik