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Visual Analysis of Social Networks in a Counter-Insurgency Context

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June 22, 2011

Background

- Changes in military operations environment*

Cold War Context	New Military Context
Well defined strategic context (Cold War)	Poorly defined strategic context (Global War on Terror)
Static theatre of operations	Multiple theatres of operations
Single spectrum operation	Full spectrum engagement
Well defined adversary	Elusive and changing adversary
Technologically predictable enemy	Technologically innovative enemy
Structured enemy forces	Networked enemy forces
Corps construct	Battle group construct
Rigid and concentrated forces	Adaptable and dispersed forces
Long term evolution cycle	Very short term evolution cycle
Limited third party considerations	Crowded JIMP environment
Controlled info sphere	Uncontrollable info sphere

- Vocabulary:
  - Irregular and Asymmetric warfare
  - Insurgency and Counter-Insurgency (Strategy and doctrine)
  - IED and C-IED

*Directorate of Land Concepts and Designs (DLCD), DND/CF, (2009), *Toward Land Operations 2021: Studies in Support of the Army of Tomorrow Force Employment Concepts*. B-GL-310-001/AF-001, Kingston, Canada.

SNA and Counter-Insurgency

- Insurgency:

> *"A part of a wider set of irregular activities and threats to a secure and stable environment."* *

- Counter-Insurgency overall objective: gaining support from the local population
  - Understanding socio-cultural environment
  - Understanding impact of taken actions
  - SA: Red – White – Blue – Brown
- SNA
  - Sociology and sociogram – Moreno [1934]
  - Mathematics, graph theories,...
  - Computer

*Department of National Defence and Canadian Forces (DND/CF), (2008), *Counter-Insurgency Operations*, B-GL-323-004/FP-003.

SNA and Counter-Insurgency

- Social networks

> "Social networks are formally defined as a set of nodes (or network members) that are tied by one or more types of relations" *

- Analysis - network level
  - Nodes: Individual, Group, Organisation
  - Links: Relationships
  - Attributes

*Wasserman, S. & Faust, K., (1994), *Social Network analysis – Methods and Applications*, Cambridge University Press, NY, USA.

SNA and Visualisation

- Information Visualisation:

> *"The use of computer-supported, interactive, visual representation of abstract data to amplify cognition." **

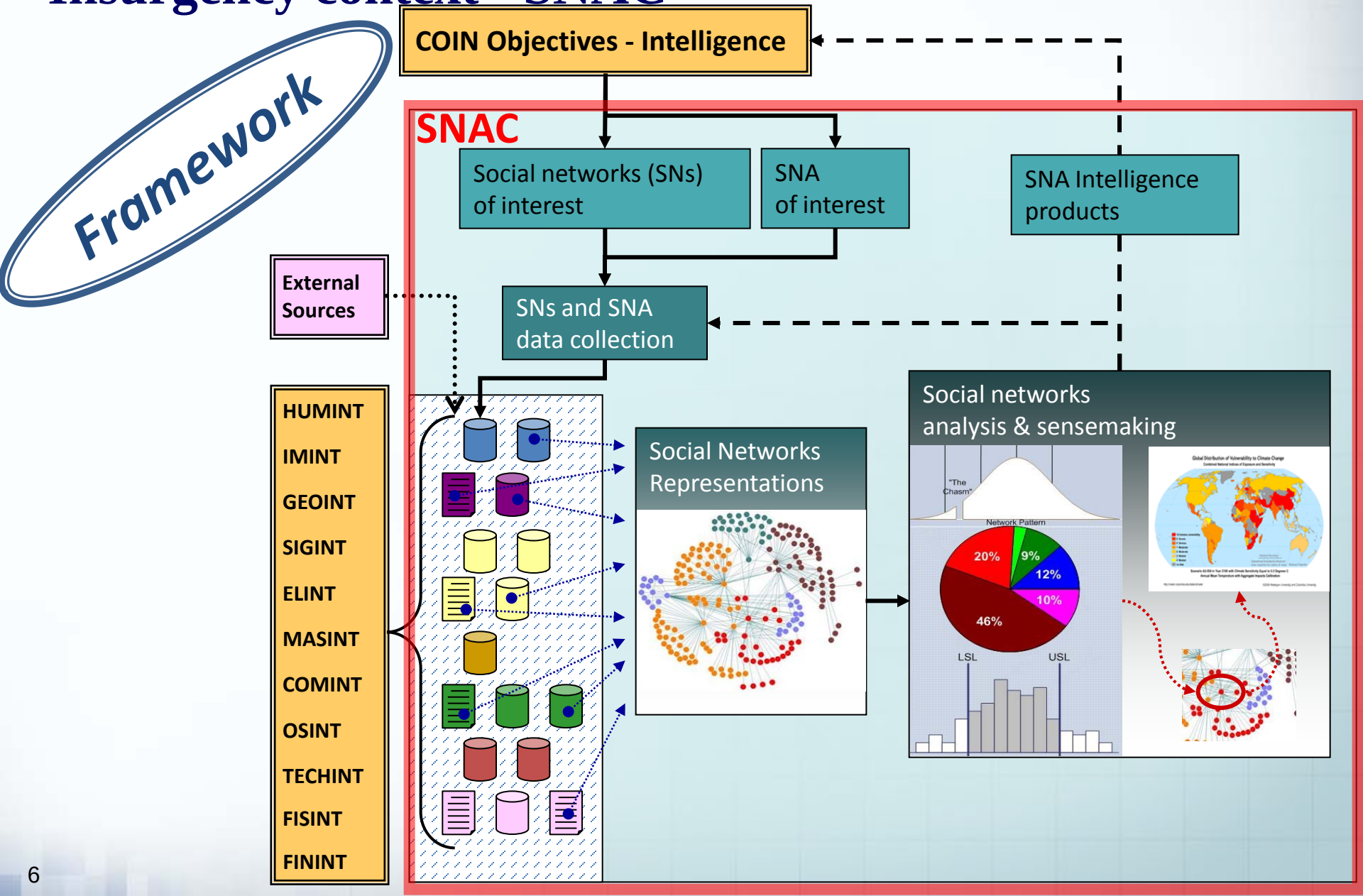
- Visual Analytics

> *"The science of analytical reasoning facilitated by interactive visual interfaces." ***

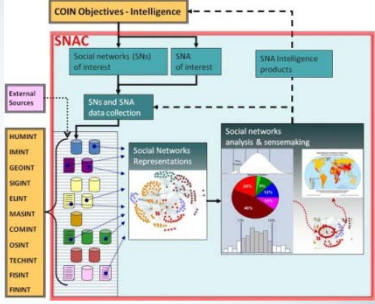
*Card, S., Mackinlay, J., & Shneiderman, B., (1999), *Readings in Information Visualization: Using Vision to Think*, Morgan Kaufmann Publishers.

** Card, S., (2008), *Information visualization*, In Sears, A. & Jacko, J.A., *The Human-Computer Interaction Handbook: Fundamentals, Evolving Technologies, and Emerging Applications*, Lawrence Erlbaum Assoc Inc.

Social Network Analysis in Counter-Insurgency context - SNAC

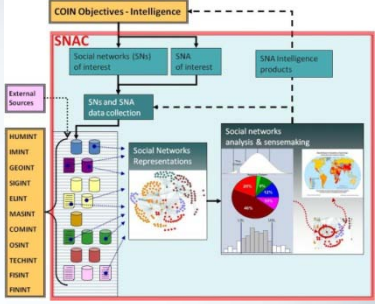


Visualisation for a SNA capability

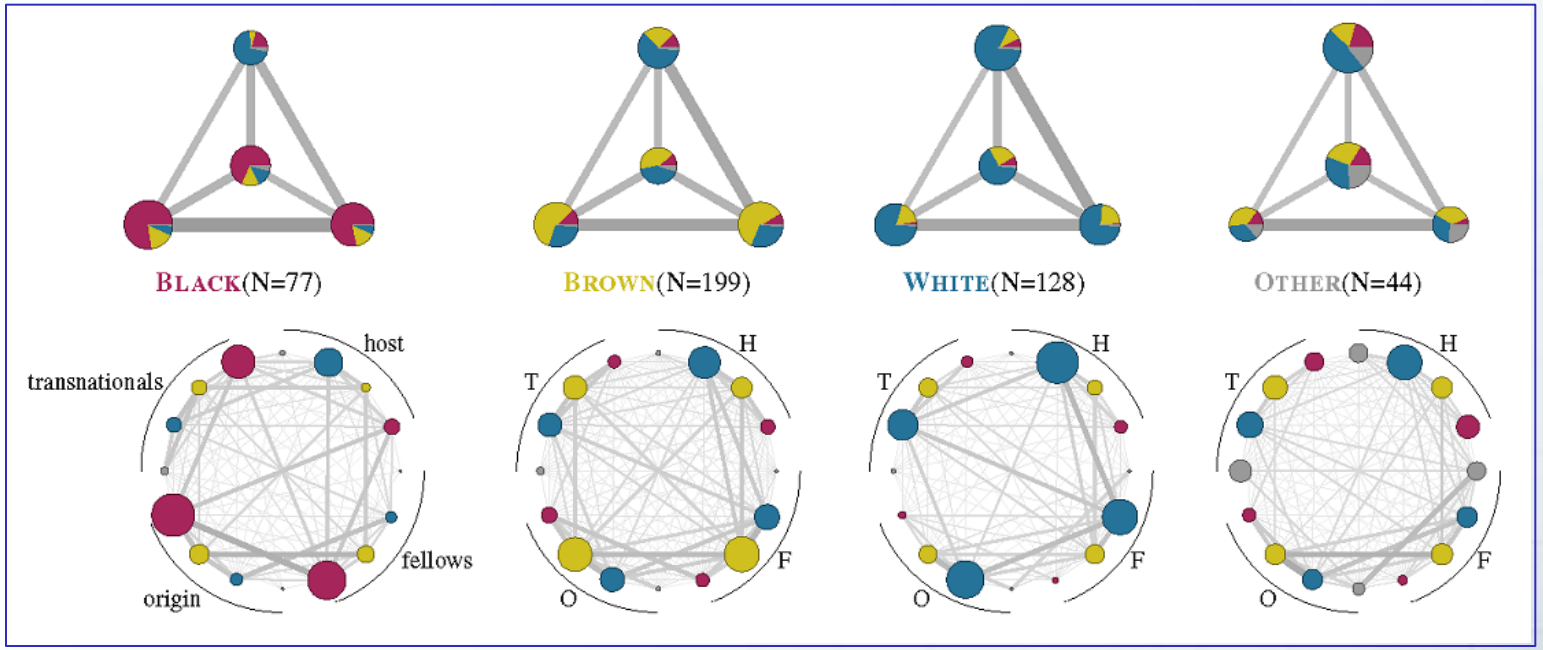


- Visualising the objectives
  - COIN strategy, objectives and issues
  - Identification of social networks of interest
  - Identification of related analysis to perform onto the social networks
    - Level: strategic – operational – tactical
    - Focus: individual – groups – network (density – clusters – etc.)
    - Domain: religion – economy – politics – criminality – etc.
- Data sources, data sets and data visualisation
  - Data sources: reliability – credibility
  - Data sets: origin – sampling – missing data issue
  - Data: context – meaning – relation to the issue/objective

Visualisation for a SNA capability



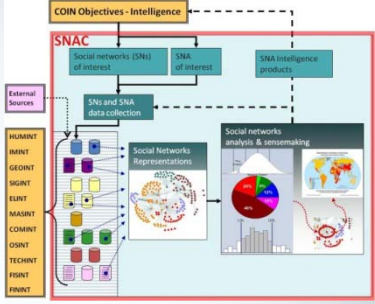
- Visualising social networks
  - Representation: computational language – machine readable
  - Visual presentation: graphs – statistics – perspective



Comparison of subclasses network topology using circular layout *

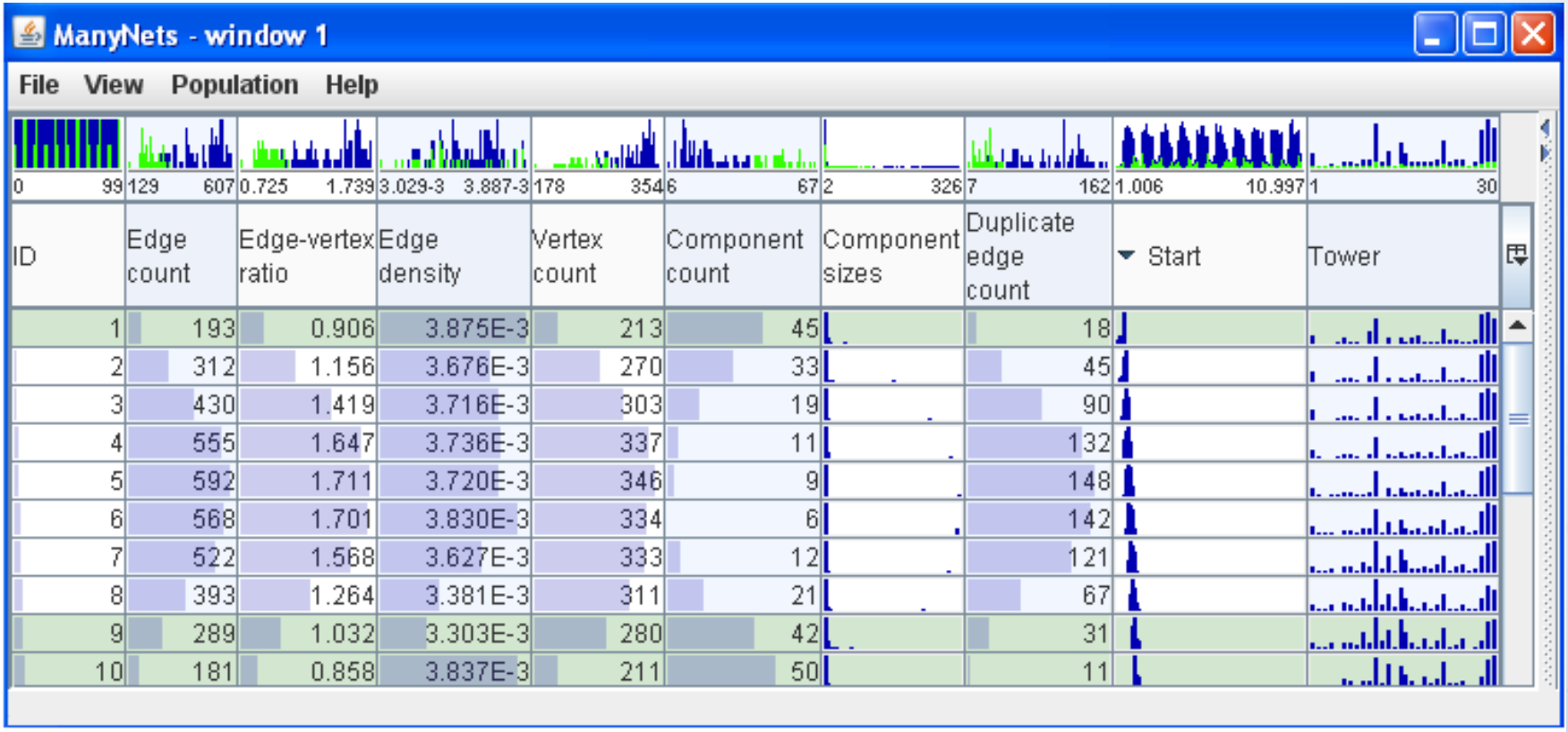
*Brandes, U., Lerner, J., Lubbers, M.J., McCarty, C., & Molina, J.L., (2008), *Visual Statistics for Collections of Clustered Graphs*, In proceedings of the 2008 IEEE Pacific Visualization Symposium, Kyoto, Japan.

Visualisation for a SNA capability



- Analysis and sense-making
  - Considering different level: Nodes – Links – Network
  - Encompassing very large networks
  - Highlighting analysis results
    - Eg.: Visualising communities
  - Comparing analyses results
    - Different sampling
    - Different timing
    - Different networks
  - Considering the attributes
- SNA product usability
  - Link to initial objective/issue
  - Context and format related to the requester

Visualisation for a SNA capability

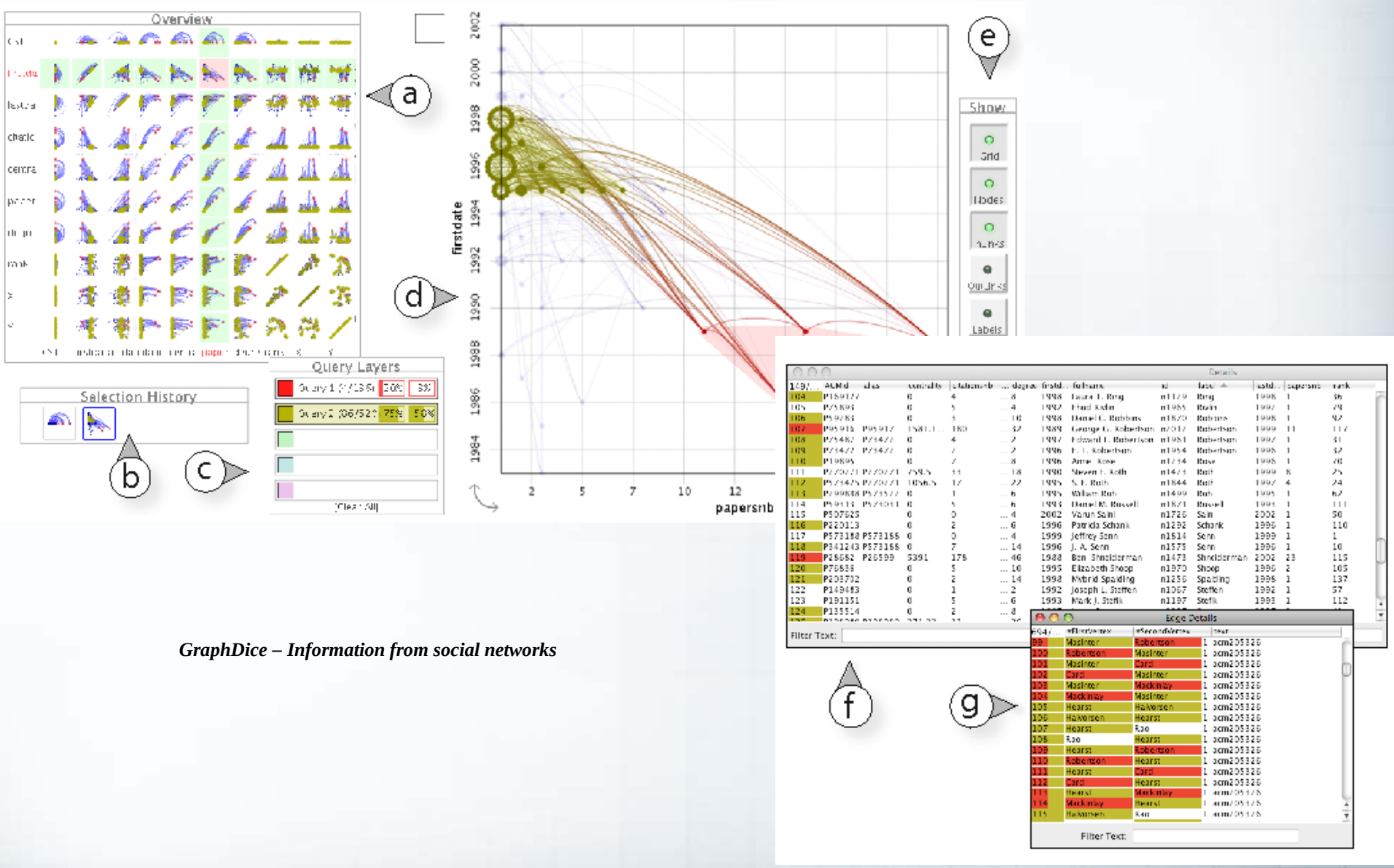


ID	Edge count	Edge-vertex ratio	Edge density	Vertex count	Component count	Component sizes	Duplicate edge count	Start	Tower
1	193	0.906	3.875E-3	213	45		18		
2	312	1.156	3.676E-3	270	33		45		
3	430	1.419	3.716E-3	303	19		90		
4	555	1.647	3.736E-3	337	11		132		
5	592	1.711	3.720E-3	346	9		148		
6	568	1.701	3.830E-3	334	6		142		
7	522	1.568	3.627E-3	333	12		121		
8	393	1.264	3.381E-3	311	21		67		
9	289	1.032	3.303E-3	280	42		31		
10	181	0.858	3.837E-3	211	50		11		

ManyNets – Networks characteristics comparison*

*Freire, M., Plaisant, C., Shneiderman, B., & Golbeck, J., (2010), *ManyNets: an interface for multiple network analysis and visualization*, Proceedings of the 28th international conference on Human factors in computing systems, pp. 213-222.

Visualisation for a SNA capability

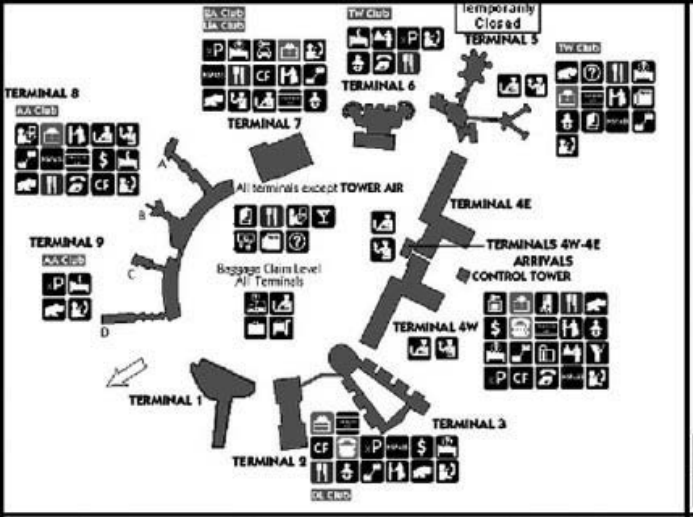


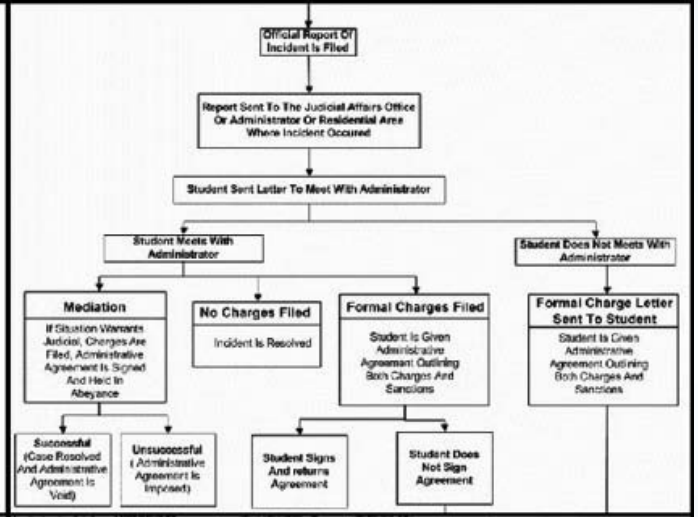
GraphDice – Information from social networks

*Freire, M., Plaisant, C., Shneiderman, B., & Golbeck, J., (2010), *ManyNets: an interface for multiple network analysis and visualization*, Proceedings of the 28th international conference on Human factors in computing systems, pp. 213-222.

Challenge 1: Complex situations

- SA: Red – White – Brown – Blue...
- Information and data from internal and external entities
- Complexity of the :
  - Situation
  - Social data
  - Interconnected components
- Requirement for “Link views”
- Importance of:
  - Context
  - Endurable elements
  - Changes





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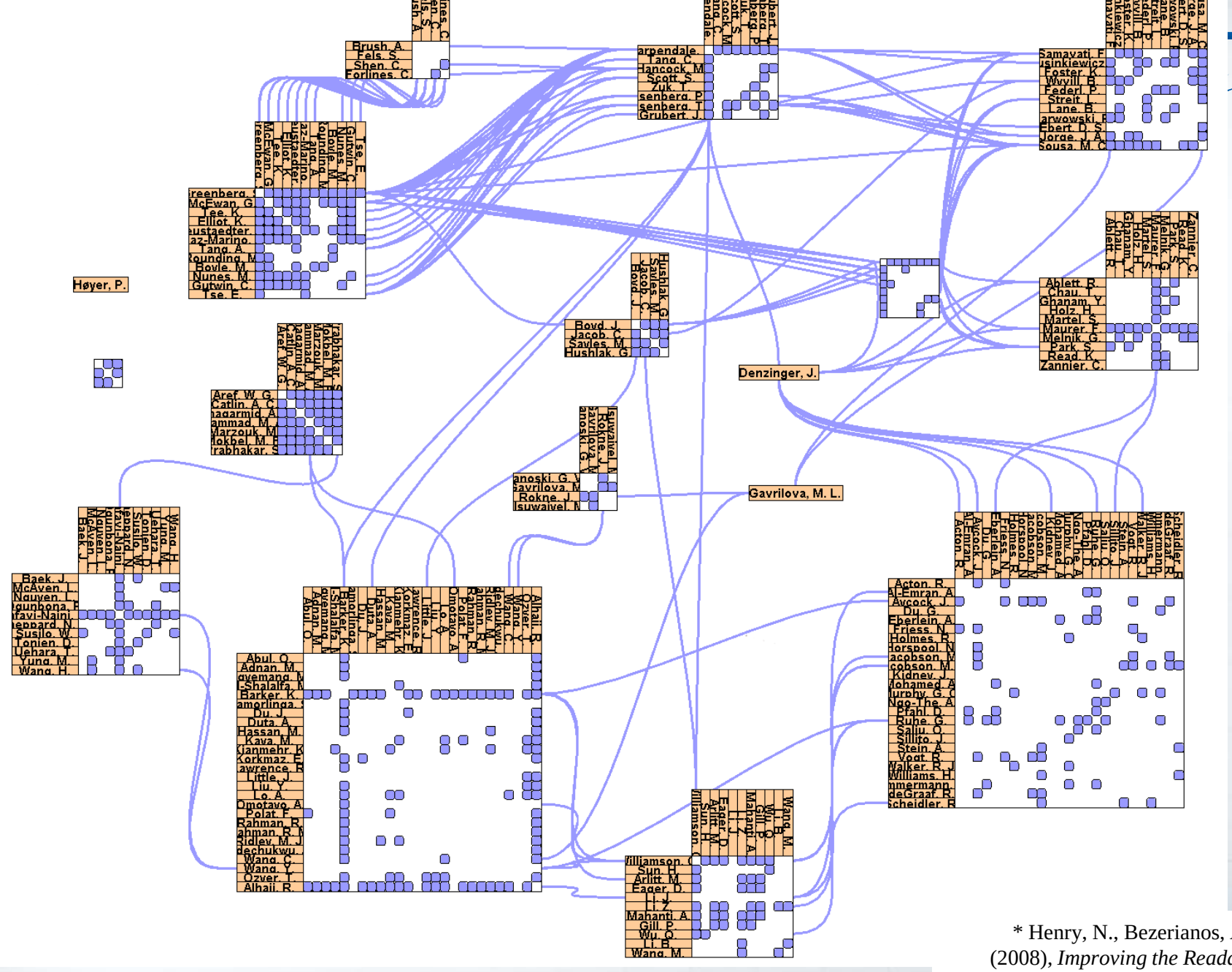
Examples of graphic displays*

*Freire, M., Plaisant, C., Shneiderman, B., & Golbeck, J., (2010), *ManyNets: an interface for multiple network analysis and visualization*, Proceedings of the 28th international conference on Human factors in computing systems, pp. 213-222.

Challenge 2: Large amount of data

- Automated/Partly-automated extraction of data
- Technologies advancements (web, social media, social networking technologies,...)
- Global structure vs. Detailed analysis of social networks
- SNA and Network mining
- Combination of graphs, matrices, statistics,...
- Identification of patterns



*NodeTrix – Visualisation for large social networks**

* Henry, N., Bezerianos, A., & Fekete, J-D., (2008), *Improving the Readability of Clustered Social Networks using Node Duplication*, In IEEE Transactions on Visualization and Computer Graphics, vol. 14, no 6, pp. 1317-1324.

Challenge 3: Sense-making

- Combine different types of visualisation or support
  - Graphs
  - Statistics
  - Matrices
  - Pixels
  - Domain Ontologies
- Take into consideration social networks evolution and changes
  - Time elements
  - Spatial components
  - Events
  - Effects

Challenge 4: Collective SNA

- Considering
  - Different types of social networks (red – white – blue)
  - Connections between those social networks
- Covert network
  - Data collection issue
  - Missing data issue
- Socio-cultural differences
- Collaboration with other organisations
  - Different standpoints
  - Different reliability
- Combining SNA to other analysis

Next steps

- State of the art report on visualisation techniques for SNA
- Identification of the visualisation techniques adapted to:
  - The Intelligence requirements
  - The pursued SNA capability
- Prototype development for the SNAC
  - Integration of existing SNA tools and techniques
  - SOA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