Science of complex systems for socially intelligent ICT

Overview of background document
Objective IST-2007.8.4
FET proactive

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Formulation

• Result of wide consultation

• Apologies if a name is not listed...
Basic Idea

• Application of Complex Systems approach for designing, understanding and modelling...

• Socially Intelligent ICT
Socially Intelligent ICT?

• ICT composed of many interacting parts
• Semi-autonomous, possibly diverging goals
• Include humans in-the-loop
• Required to coordinate and cooperate socially to achieve collective goals
• Socially Intelligent ICT facilitate this through mechanisms of social coordination
Why Now?

• Emergence of global scale distributed ICT as major application domain
  – Massive (10m’s)
  – Distributed (lack of central control)
  – Open (unknown new behaviours)

• Increasing use of ICT to mediate, create and enable communities (techo-social communities)
Why Now?

• Recent example applications:
  – Social networking
  – Wiki-based content creation
  – Social tagging
  – Peer-to-Peer systems

• Compare: Social software (Web 2.0)
Why Complexity Science?

• Maturing body of work providing:
  – Scientific results: empirical & analytic
  – Tools: models, formalisms, measures
  – Methodology: simulation, analysis

• For modelling, predicting and designing complex adaptive systems

• Can help where traditional engineering approaches struggle
Why Complexity Science?

• Many relevant domains – e.g:
  – emergent network structures
  – trust and cooperation
  – formation of sustainable communities
  – evolutionary economics
  – computational sociology
  – econophysics
Why Complexity Science?

• Provide alternatives to “rational action”:  
  – Realistic models of user behaviour  
  – Localised and noisy information  
  – Bounded computation  
  – Bounded rational models  
  – Evolutionary models of behaviour  
  – Psychology and experimental economics
Vision and Challenges

- Produce effective models of techno-social systems
- Avoiding commons tragedies without central control
- Controlling malicious behaviour & noise
- Efficient reputation systems preserving privacy
Three broad challenge areas

- Theoretical and algorithmic foundations
- Data-driven simulation
- Prediction and predictability
Theoretical and algorithmic foundations

- techno-social systems are complex
- required multi-level modelling
- micro, macro and meso scales
- previous models often focus only on:
  - micro or macro levels
  - micro to macro level relationships
- need feedback from macro to micro
- realistic diversity of behaviours and social and spatial structures
Data-driven simulation

- Social and economic models often ignore empirical data (abstract/ theoretical)
- Derive models of techno-social systems empirically - need tools and methods for:
  - collection and processing of huge noisy datasets to derive multi-level dynamic models
  - probing technologies in date rich environments
  - design of protocols and experiments (humans)
  - scalable and distributed knowledge extraction
- Validation methods (not just curve fitting)
Prediction and predictability

- Complex systems and human systems are difficult to predict
- But statistical signatures, patterns, can be found. For given systems:
  - what is the appropriate predictive level?
  - what are the limits to predictability?
  - what are the relationships between predictive, descriptive and theoretical / abstract models?
- Understanding the limits of predictability valuable for engineering and design
Vision and Challenges

• Potential application domains:
  – massive ICT mediated service economies
  – ICT mediated communities
  – Peer-to-Peer systems
  – emergency and disaster relief systems
Source Documents

Background document:

Complexity Research Living Roadmap:

Complex Systems Research in FP7 document:

See FET FP7 closed consultations at: