A European perspective on research evaluation

Peter Johnston
European Commission
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A key enabler for realising the Lisbon goals

- **The Kok report**
  - ***"The EU needs a comprehensive and holistic strategy to spur on the growth of the ICT sector and the diffusion of ICTs in all parts of the economy".***
- **The Commission's proposal to the Spring Council : Working together for growth and jobs**
  - ***The EU's innovation performance is crucially dependent on strengthening investment and the use of new technologies, particularly ICTs"***
  - ***Investments in ICTs in Europe have been lower and later than in the US,***
  - ***An increased investment in research and innovation in ICTs is essential to boost innovation, growth and jobs creation***
  - ***A new initiative i2010 will be proposed as a comprehensive ICT policy***

ICT research and innovation – a tool to realise EU policy priorities

- **An important sector in its own right : From 3-4% of EU GDP in early 90s to 5-6% in 2005;**
- **A key enabler for productivity growth & competitiveness: ICT investments contribute half of Europe's productivity gains**
- **ICT-based innovation is a key facilitator for more efficient public services, more participation in democracy and public life, and for addressing the societal challenges of an ageing population.**
- **ICT underpins progress in all science & technology fields:**

New orientations for research evaluation

- **More focus on outputs and impacts;**
- **Verifiable objectives and indicators;**
- **Higher-quality "evidence-base";**
- **More focus on "systemic" effects, notably in the research-innovation-competitiveness links, and on "knowledge networks";**
- **More attention on the EU "added-value";**
- **Linked ex-ante – ex post evaluations;**
- **Adequate resources and an expanded programme of evaluation studies**

Private or public returns from ICT research and technology development ? (Nordhaus, 2004)

- **In 2005, ICT innovators capture about 2% of the total social gain from technological progress**
- **The US stock market valuation of 'new economy' firms grew between 1995 and 2000 at a rate that implied owners could capture 90% of the social gain**
- **Yet the appropriability of gains from ICT unlikely to match that of earlier technologies including railways**
- **=> Focus on the societal benefits**

Slide from Nicholas Crafts conference (2005)

Returns on investment in IST-RTD

Sales of innovative product; Reduced process costs; Licence income; Use of technology in other parts of the business

Spillovers to non-participants:
User and social benefits

Following Luke Georghiou, PREST 2005

The new environment for ICT-research and technology development

- **National "return" is expected from national public R&D funding. However …..**
- In the past, there was a coherent but inefficient framework: national R&D + national champions

  Today, R&D is far more complex
  - Firms go global (disintegration of the value-added chain)
  - Global R&D teams
  - Direct national employment is no longer realised because of the labour-deflationary impact of productivity gains and massive ICT manufacturing offshore;
  - Wider business and social benefits arise from use of ICT innovations appropriate to local needs, from where-ever it arises, but these depend on the effectiveness of the "**RTD-innovation-take-up"** system.
  - However, there are still substantial benefits from scientific and technological leadership – in **setting standards and the research agenda.**

Evaluation and impact assessment of the RTD and innovation system at the EU-level

- **Beyond "outputs" to "impacts"**
- **"systemic" analysis, rather than aggregation of "project-level" results;**
- **"societal benefit", rather than "private return"**

A three track strategy in 2003-6

- **Network analysis;**
- **Intervention-logic/Causality analysis;**
- **System dynamic simulation**

Why "network analysis"

- *"The new model of business R&D is a model of open innovation where firms can tap into world-wide talents pools and acquire external technologies through licensing, **collaborative research**, mergers and acquisitions"*

US Dept of Commerce – "More for less…" 2005

Knowledge is Networked

- **Innovation requires combining scientific, design, engineering and operational knowledge from different sources**
- **An individual or organization rarely has all the knowledge needed for the whole process of innovation**
- **The types of skills and knowledge of research activity is unknown at the start**
- **The most efficient way to create knowledge is enable researchers themselves to identify what is needed, to find each other, link up, and share resources**
- **The knowledge-creating process can be facilitated by understanding how this happens**

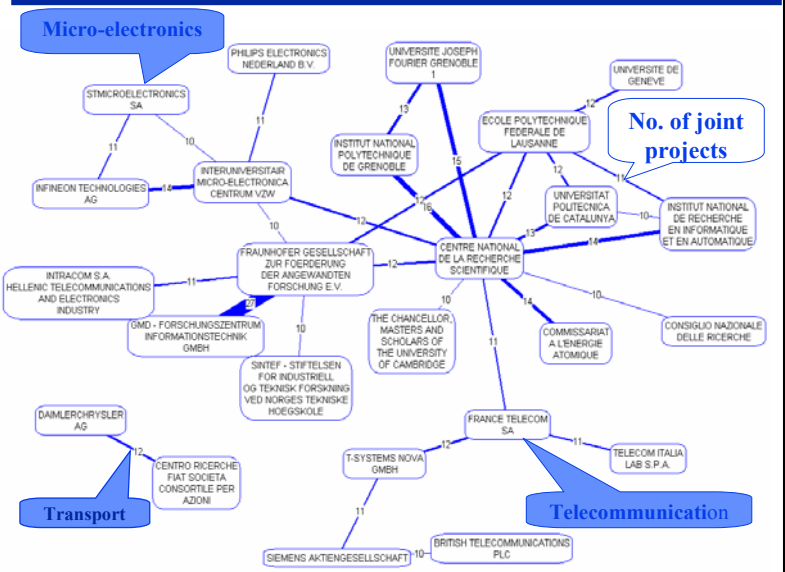
Networking objectives of EU research support

- **Creating "critical mass" - bring together enough intellectual and financial resources to realize the next breakthrough;**
- **Stimulating innovation - sparking off the new ideas by bringing together people in different disciplines and different environments;**
- **Integrating the European Research Area – Including New Member States and SMEs ;**
- **Disseminating knowledge - giving more people access to the latest scientific knowledge.**

Developing a strategy for network evaluation and impact assessment

- **Demonstrate the feasibility and potential of network analysis (JSI - 2002-3);**
- **Evaluate the impacts on the ERA research networks of the transition from the 5th to the 6th FPs (RAND - 2004-5);**
- **Evaluate the contribution of FP in global networks for IST-RTD and innovation (CRESPI - 2005-6);**
- **Evaluate research and innovation networks – How to strengthen innovation in Europe?**

Collaboration between research organizations in 1998-2002 : the 5th FP

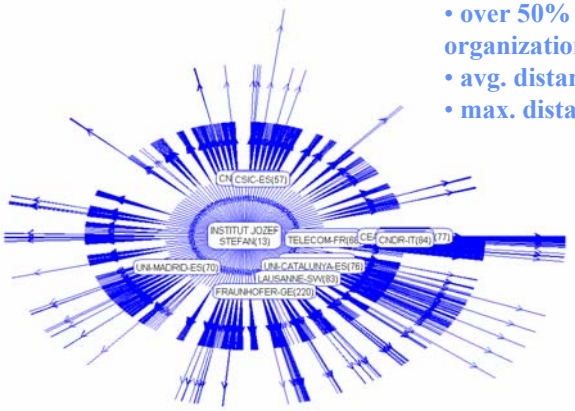


Key observations (2002)

The network of research collaborations has:

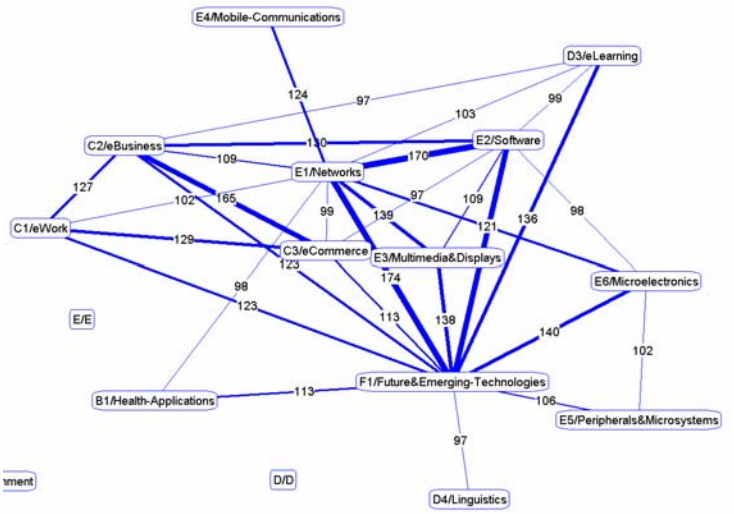
- **A self-organizing structure, dominated by "hubs", which are also key nodes in National research networks;**
- **A scale-free (self-similar) architecture at the thematic levels;**

A "small world" with key nodes of connectivity – Network collaboration for J. Stefan Inst.



- 179 collaborations,
- over 50% of organizations at 2 links
- avg. distance is 2.42
- max. distance is 4

The thematic network of IST-RTD collaborations in 1998-2002



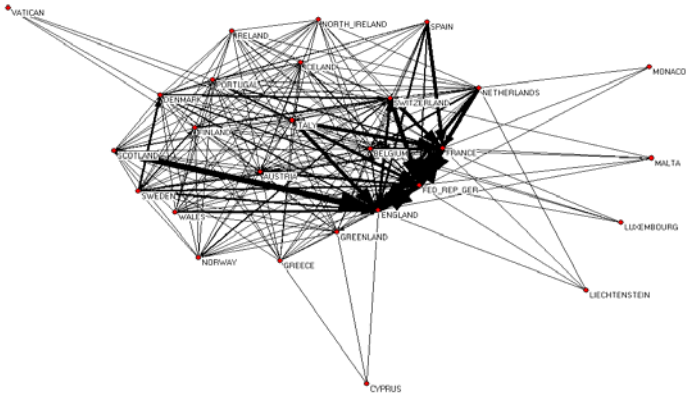
Conclusions (2002)

- **We have "small world" connectivity in European research;**
- **We still have strong clustering within national research communities : Researchers are still 4 times as likely to co-operate with a colleague of the same nationality as with someone of another European nationality;**
- **We have strong clustering with research disciplines and within industrial sectors;**
- **The funding structure has a strong influence on research co-operations.**

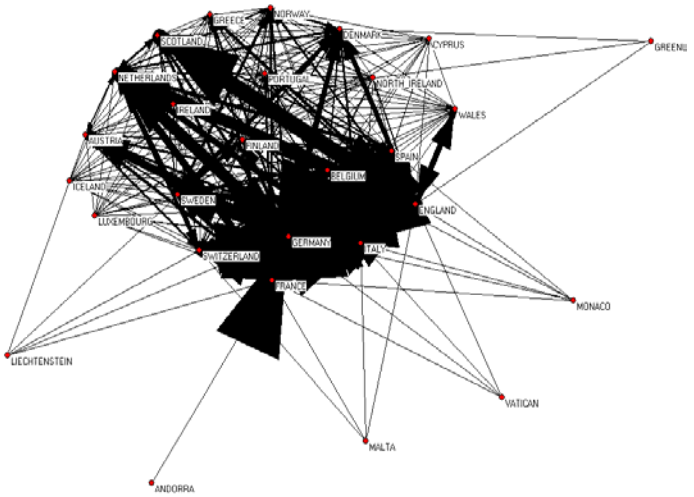
The changes in 2003 (5^{th} – 6^{th} FP)

- **Increase project size - larger projects, with more collaborating partners :**
  - **to create critical mass within a more coherent funding framework, and**
  - **to increase the number and diversity of links.**
- **Increase inter-disciplinary co-operation within the major National research "hubs"**
- **Stimulate cross-disciplinary research within the European funding framework**
- **Monitor the network evolution over time with respect to the coherence of national and European research investments.**

RTD Collaboration in Europe - 1990



RTD Collaboration in Europe - 2000



As a result of the new "Integrated Projects" and "Network of Excellence"

- **The density of links is higher (120 vs 22 per project);**
- **The % of participants in the main core is higher (98% vs 95%);**
- **The Average path length is lower (2.63 vs 3.15);**
- **Large institutes and companies are more dominant – as gate-keepers of collaboration** (FhG participates in 80 of 350 projects vs 180 of 2800 in the 5th FP);
- **Small companies are "crowded out", compared with the 5th FP.**

Further conclusions by RAND 2005

The 6th FP is more likely than other research collaboration frameworks to:

- **Connect universities and business;**
- **Connect different themes;**
- **Include new Member States;**
- **Include key patent-holders;**
- **Include SMEs**

Next steps: 2005

- **Broadening RTD network analysis to the "ERA in the Global context": CRESPI (2/05-12/05)**
- **Clarifying the "causality links" between IST-RTD and FP and "Lisbon" objectives : Technopolis (10/04-12/05)**
- **Initiating the systematic use of key indicators for monitoring the output and impact of IST-RTD at the Strategic Objective-level;**

Objectives of the CRESPI analysis

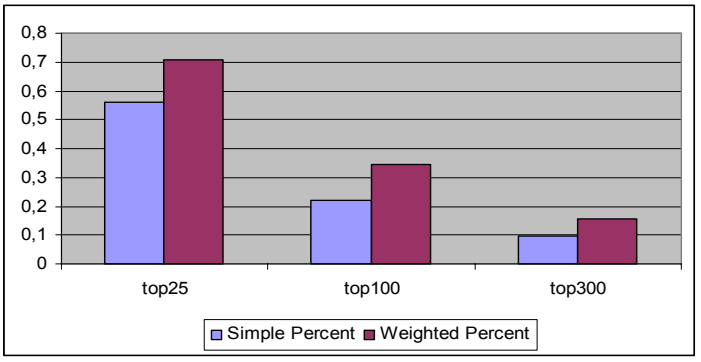
- **Whether and where EU organisations are key "hubs" in global knowledge networks? How are key European projects and networks positioned?**
- **What makes "hubs" effective? How to support the emergence of new ones?**
- **Is "collaboration leadership" reflected in output indicators?**
- **Are the European networks sufficiently inclusive of national and SME networks – notably of SME networks involved in supply-chain and application innovations?**
- **Can we get data and assess knowledge flows to innovation associated with the mobility of researchers?**

EU and global RTD and innovation :

Four inter-related networks

IST-RTD Network	European network formed by organisations participating in IST projects	Internal EC Database
Global Innovation Network	Global network formed by companies involved in privately funded strategic alliances	INNET dataset (Thomson Financial)
The Patent Network	Knowledge network arising from cross-organisational patent citations	EP-CESPRI dataset (European Patent Office)
Mobility Network	Network arising from cross-organisational mobility of scientists and engineers	EP-CESPRI dataset (European Patent Office)

Few Global innovation "hubs" are European, but a large faction of them participate in IST projects…



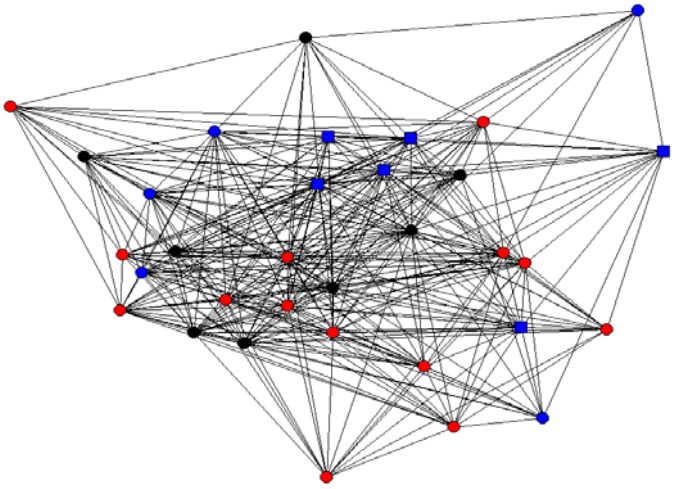
… The EU framework programme is able to attract Global innovation hubs!

IST-RTD addressing economic and social challenges

blue=Industry
red=Higher Education
black= Public research centres

○=IST-RTD Hubs
□=Gatekeepers to global innovation

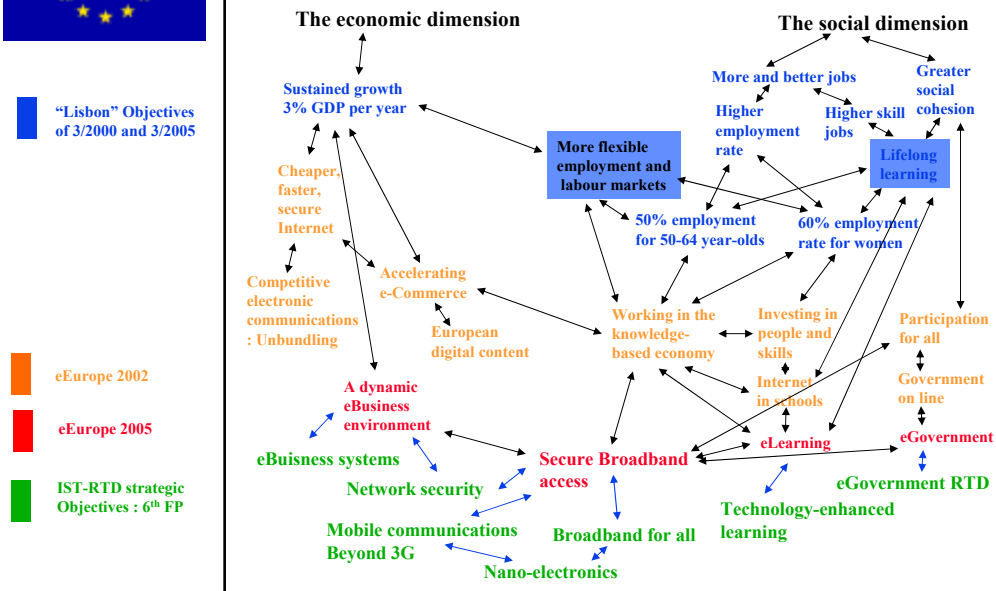
A large number of Global innovation hubs are also hubs in the IST-RTD Network



Intervention logics and causality

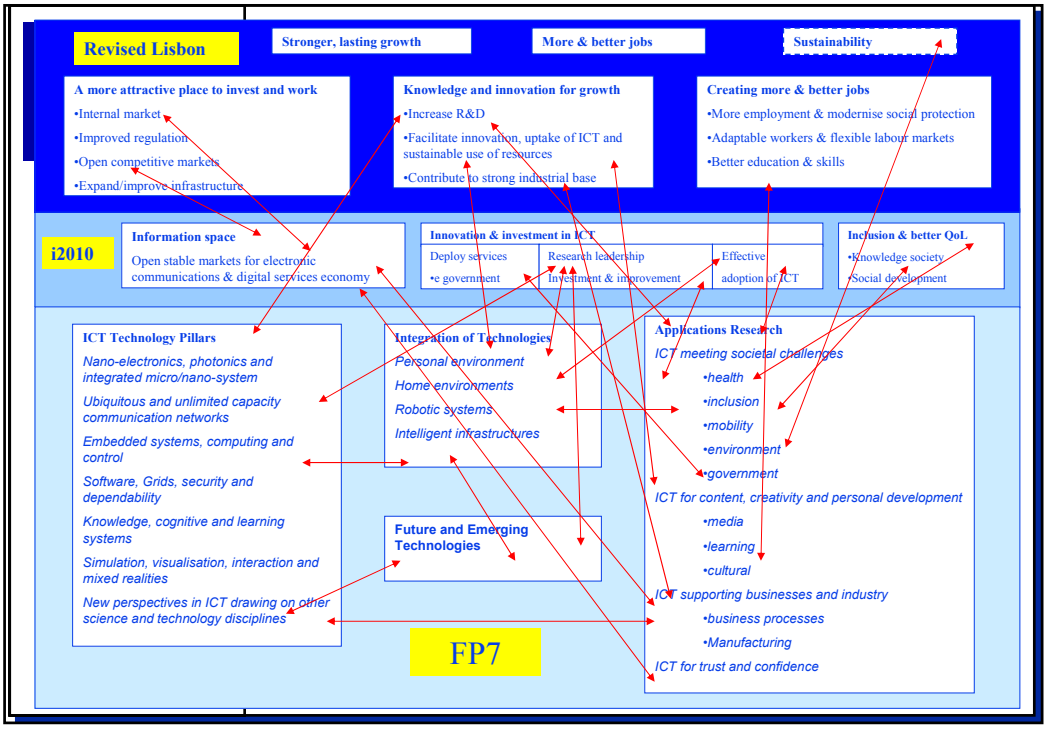
- **Can we relate investments in RTD, outputs and impacts at the level of EU policy goals?**
- **Can we identify an "intervention logic" for IST research and technology development as a whole?**
- **Can we identify where in this "causality" linkage we could best monitor impacts of the RTD ?**

Addressing social and economic goals through information society developments – i2010



Three different logics

- **Horizontal logic**
  - **Exploring interdependency between high level objectives or between intermediate level actions (ie the proposals for FP7) as per previous example**
- **Vertical logic**
  - **Exploring interdependency between an objective and the relevant parts of FP7**
    - **Can isolate as binary link, or**
    - **Consider combined effect of all aspects of the Programme on that objective, or**
    - **Consider multiple effects on objectives of a single Programme activity**
- **Systemic logic**
  - **Considering implications of change across the whole system**



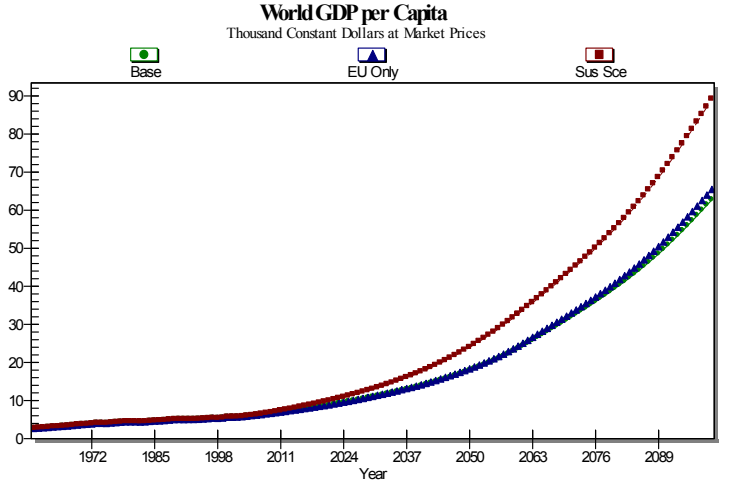
Key findings by Technopolis - 2005

- **If an "intervention logic model" has not been used to design the research investment, it cannot easily be used retrospectively to evaluate effectiveness;**
- **Different "Strategic Objectives" in IST-RTD have different intervention logics. No single "logic model" applies, and indicators of output and impact cannot simply be aggregated;**
- **The different "Strategic Objectives" constitute a portfolio of synergetic interventions, which requires an systemic approach to the evaluation of the whole programmes effectiveness.**

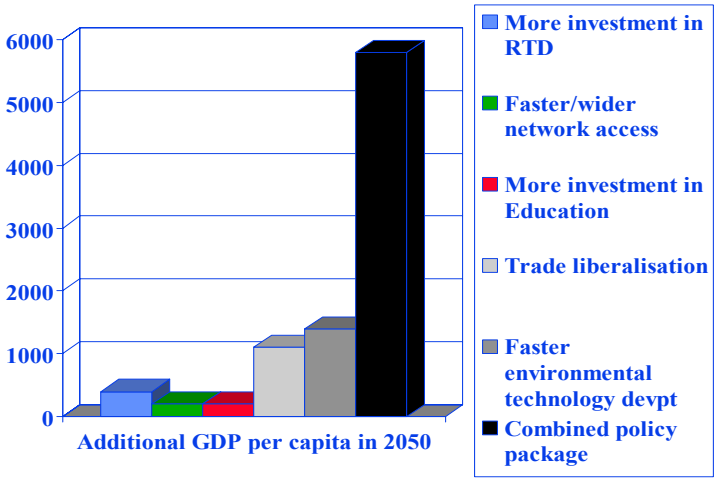
System dynamics : the top-level view

- **The evidence base: Over 200 parameters of economic, social and environmental performance and correlation with policies - for 160 countries – for 40 years.**
- **A "base case":– No change. Investments in education, R&D, innovation evolving only with growth. Historic rates of improvement in energy and resource productivity.**
- **A "sustainability policy package": – of increased investment in education, health-care, R&D; wider network access and faster "environmental technology" development; Further liberalisation in international trade, and carbon taxation.**

World growth to 2100 : Faster growth with Sustainable development policies, but the EU cannot act alone.



*Additional EU GDP per capita in 2050 from separate and combined policy measures: **Simulations compared with a base case 45,400 Euros at PPP***



Next steps: 2006

- **Consolidating the systematic use of key indicators for monitoring the output and impact of IST-RTD at the Strategic Objective-level;**
- **Identification and assessment of the capabilities of "system dynamic" model and tools for macro-economic/social impacts of investments in IST-RTD and ICT deployment : Contracted in Dec 2005;**
- **Extending network analysis from RTD to include innovation and deployment : Contracted in late 2005.**

The key question

How do we bring together "network analysis", "output indicators"; "causality models" and econometric and dynamic simulation models of macro-economic/social impact in the next major budget and programme evaluations in 2008-9?

- **Many thanks !**

- **Peter.johnston@cec.eu.int**