

ECCS'09 Satellite Workshop (Warwick, UK)  
"Putting Complexity to Work - Supporting the Practitioners"  
24th September 2009

# **Bridging the gap between complexity practitioners and scientists**



## **Thinking out-of-the-box**

**Erik De Man**

**... from the battle field  
of geographic  
information – science  
& practice ...**



# Issue in general & my background



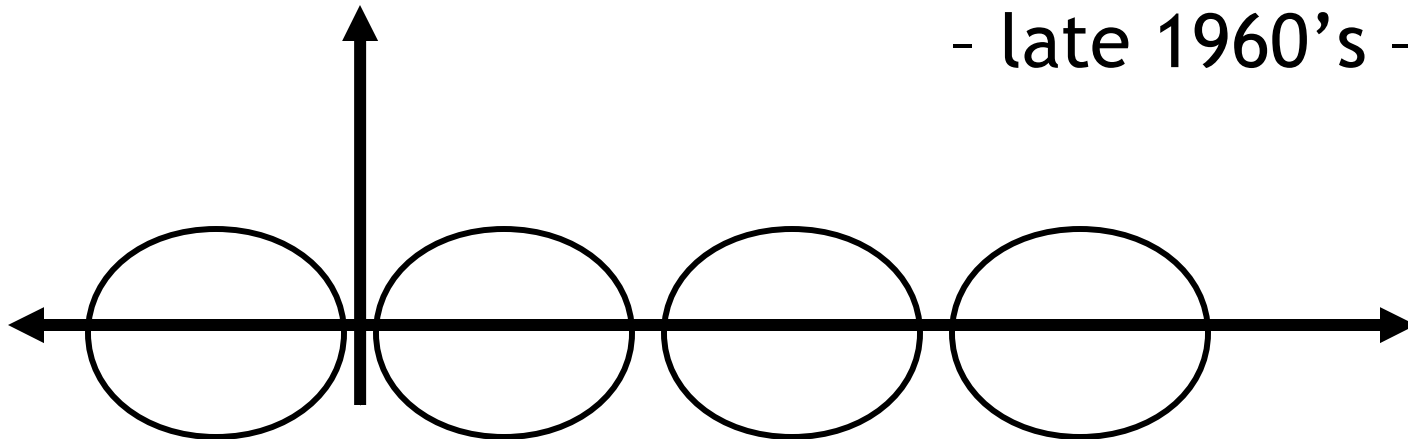
- “Putting Complexity to Work”
  - Relevance of science
    - problematic
      - applicability – for whom?
  - Gap between science & practice
- Geographic Information Science
  - complexities and dilemmas

# My background: How can GI matter?



“Integrated surveys” – Aerial Photo’s  
Vertical integration into decision-making  
& governance

(ITC-Unesco Center for Integrated Surveys  
- late 1960’s –1980’s)



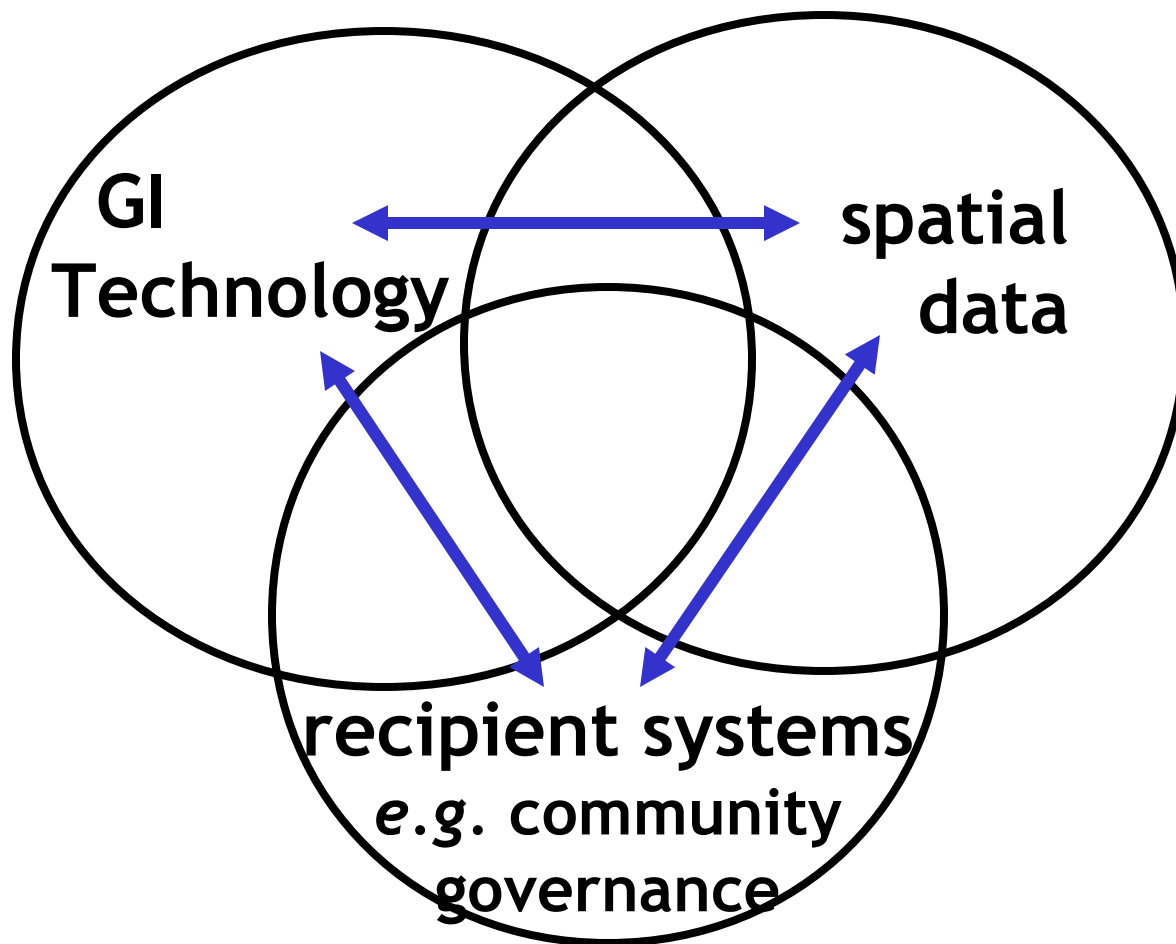
Horizontal integration between disciplines  
(Unesco - Toulouse 1964)

# *From the outset ... Science & Practice*



- Necessarily “social”
  - Socio-technical Actor-networks
  - Objects are subjects
    - Dilemma-oriented
  
- Reassembling the social
  - Actor-Network Theory Latour (2005)
  - Social science that matter Flyvbjerg (2001)

# Domain of GI Science



# *In the following ...*



- Complexities and dilemmas in GI Science
  - Spatial data
  - Geographic Information Technology at large
  - Practice – ‘recipient system’
- Coping with dilemmas in GI Science
- Generalize to science & practice
  - Complexities & dilemmas
- “Putting complexity to work”
  - Transdisciplinarity – “thinking out-of-the-box”



# Dilemmas in GI Science



- who “owns” the legend?
- standardization versus multiple perspectives of reality – ‘local knowledge’
- technical (positivist) science versus socio-technical science
  - objective (thin) observations versus rich insights
  - generalization versus particularization
  - depth versus breadth
- ...



# Coping with dilemmas in GI Science



- “Institutionalization of GI Technology”  
– discourse

De Man (1988, 2000, 2006)

- Structuration Giddens (1984)

- Duality of technology Orlikowski (1992)

- Ethnography of Infrastructure Star (1999)

- Participation – e.g. Participatory GIS

[www.ppgis.net](http://www.ppgis.net)

# *In the remainder ...*



## I will argue

- Bridging the gap between science and practice
  - complexities
  - dilemmas
- Relevance of science
  - reconciliation of multiple complexities

# *In the remainder ...*



## I will also argue

- Complexity within the ‘recipient system’ is
  - source for robustness
  - adaptation & change
- ‘Complexity scientists’ must take into account the complexity within the ‘recipient system’
  - and the dilemmas that come with it
- ‘Transdisciplinarity’ – bridging the gap between complexity practitioners and scientists
  - mutually “thinking out-of-the-box”

# Bridging the 'science & practice' gap



## Two-ways:

- Science explains practice Galilei (1632)
  - 'arm chair' – distance
  - positivism
- Science performs practice Callon (2007)
  - self-fulfilling discourse Ferraro et al. (2005)
  - design science



# Bridging the 'science & practice' gap



- Action research
  - practical concerns & goals of social science
  - real-time, on-going, involved, joint learning-by-doing, intervention
    - e.g. “Ethnographic Action Research”  
Tacchi et al (2003)
- Theory in practice – “reflective practitioner”  
Schön & Argyris
  - paradoxes & dilemmas: basis for theory building

# *But ... What are dilemmas ?*



- Dilemmas

- value conflicts – no easy and straightforward solutions / compromises
- ‘wicked problems’ – solutions and problems are intertwined & multiple uncertainties  
Rittel & Webber (1973); Masser (1980)

- non-trivial problems for
  - research
  - professional expertise
  - ethics

Argyris & Schön (1974)

# *But ... What are dilemmas ?*



*Probably in the extreme:*

- Dilemma
  - choice between “A” and “non-A”
    - e.g. standards *versus* flexibility
  - “Logic of the excluded middle”:
    - no “Third (T)” that is both “A” and “non-A” simultaneously

See also: Nicolescu (2002); Max-Neef (2005)



- And what is ‘complexity’?



# “Ten principles of Complexity”



- self-organisation
- emergence
- connectivity
- interdependence
- feedback
- far from equilibrium
- space of possibilities
- co-evolution
- historicity & time
- path-dependence

Mitleton-Kelly (2004)

# Complexity (1)



- things relate but don't add-up
- more than one but less than many  
Mol & Law (2002)
- does not necessarily develop into stability
- as reciprocal mutuality of individual actors  
Chunglin Kwa (2002)
- crosses disciplinary boundaries  
Mitleton-Kelly (2004)

# Complexity (2)



- mask for simplicity because of redundancy

Simon (1981)

but

- redundancy – necessary condition for
  - diminishing uncertainty
  - maximizing reliability – robustness

Landau (1969, 1973); Rosenhead (1980a, 1980b)

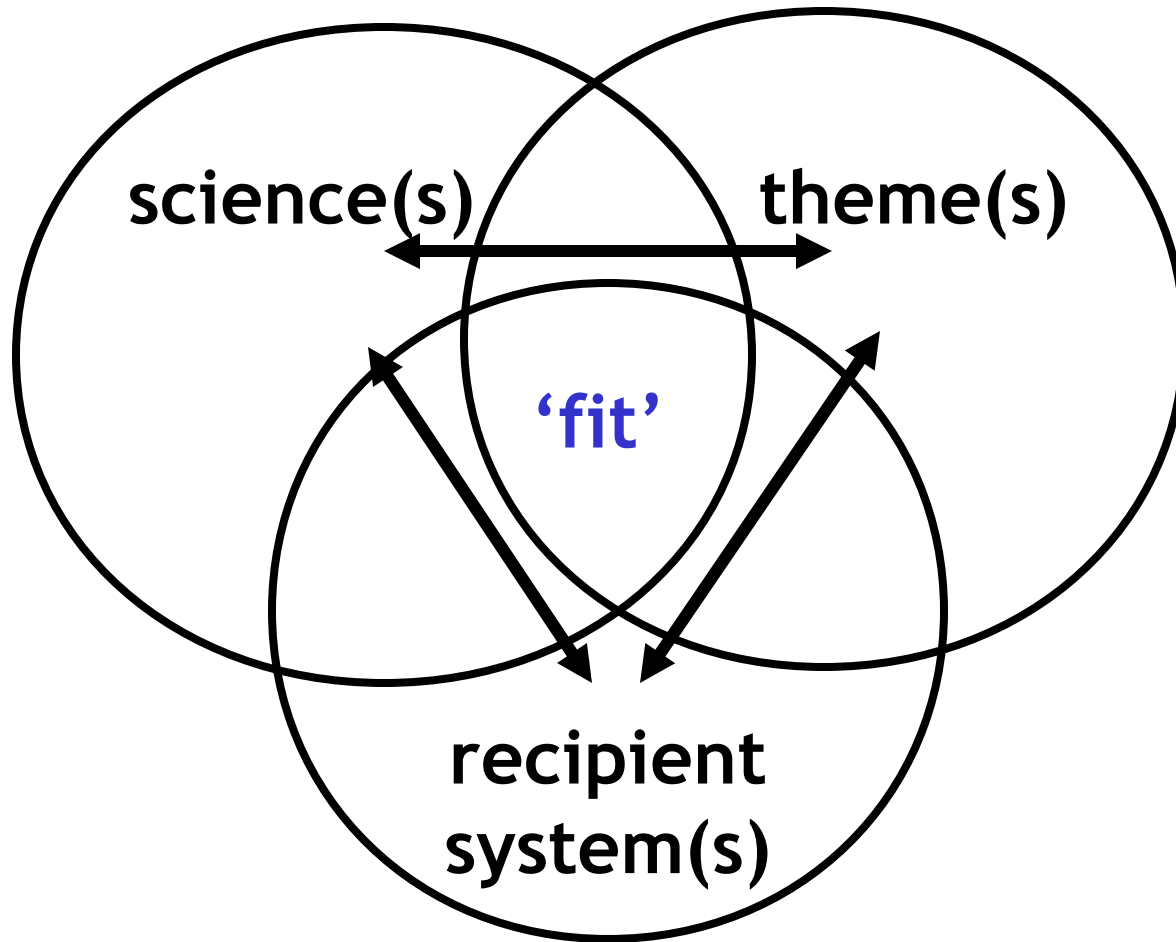
# Complexity (3)



*In summary I suggest*

- Rather than to be controlled, complexity is:
  - quality in its own right
  - not ‘complexified’ simplicity
  - source for robustness & change
  - dilemmas – conflicting values; non-trivial problems

# Relevance of Science (1)



reconciliation of multiple complexities

# Relevance of Science (2)



- Acknowledge complexity of ‘recipient system(s)’

- condition for robustness – sustainability

- complex, institutional development

- ‘coping with tragedies of the commons’ – institutional diversity & development

Ostrom (1999, 2005)

- ‘institutional economics’ – transaction costs

Williamson (1998)

- ‘theory of structuration’

Giddens (1984)

# Relevance of Science (3)

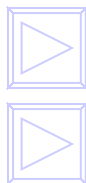


- How to keep the needed, adaptive complexity & robustness of ‘recipient system’?

# Complexity Science & Research



- ‘Requisite Complexity’
  - “one should acknowledge multiple realities shaped by heterogeneous and reflective actors” Hilhorst (2004)
- ‘Subjects’ are ‘object’ of research
  - Actor-Network Theory (ANT) Latour (2005)
  - ‘Social sciences that matter’ Flyvbjerg (2001)
- Dilemmas are ‘object’ of research
  - different actors → different realities  
→ different rationalities → dilemmas





# Dealing with dilemmas (1)



- Dilemma
  - different actors → different realities
    - different rationalities
  - choice between “A” and “non-A”
- Dealing with dilemmas
  - no simple compromise
    - “thinking out-of-the-box”
      - transdisciplinarity

# Dealing with dilemmas (2)



## What sort of disciplinarity can handle dilemmas?

McGreror (2004, 2008)

- mono-disciplinarity
  - multi-disciplinarity
  - pluri-disciplinarity
  - inter-disciplinarity
  - trans-disciplinarity
- single reality
- ↓
- multiple realities

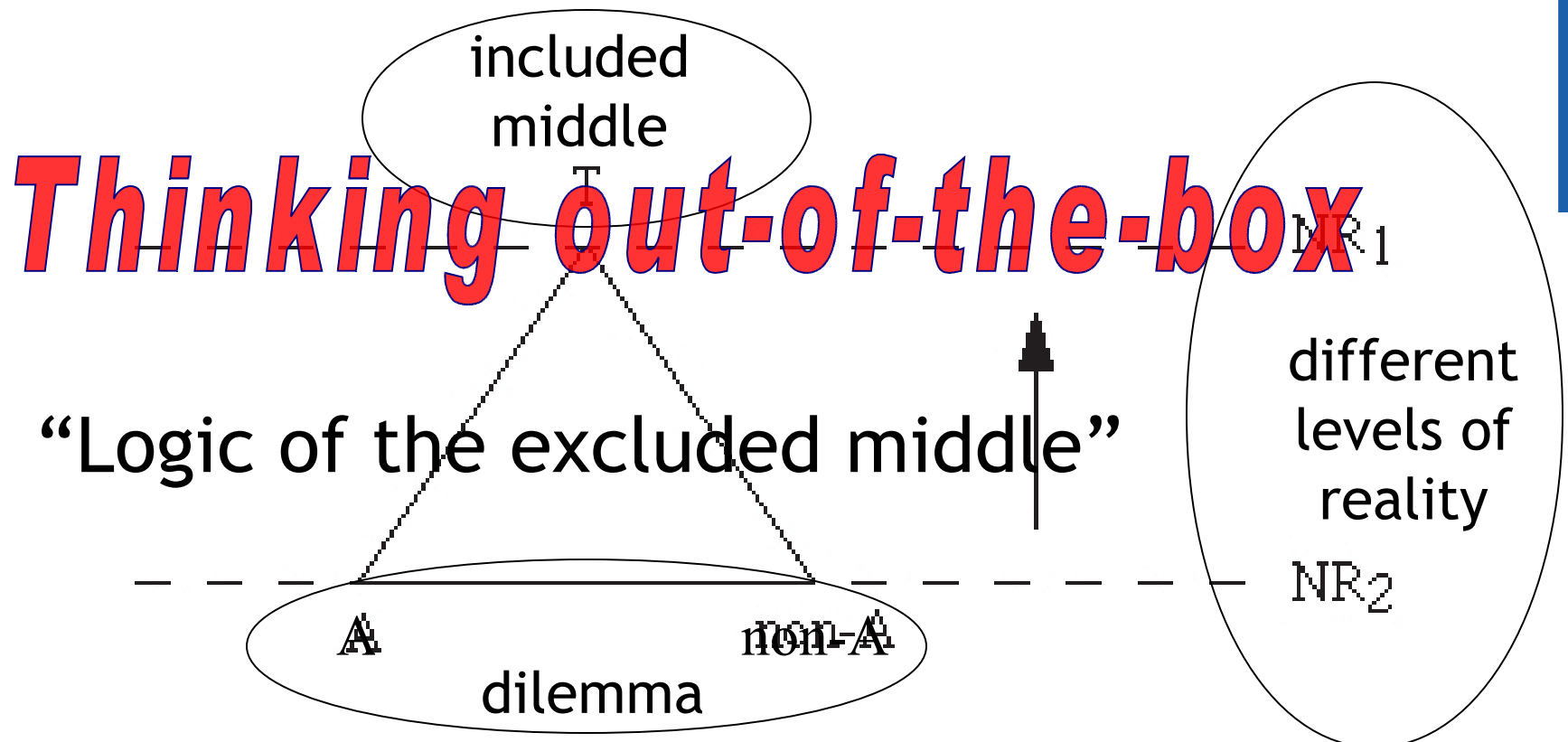
Nicolescu (2002); Max-Neef (2005); Tress *et al.* (2003)

# Dealing with dilemmas (3)



How transdisciplinarity handles dilemmas

“Logic of the included middle”



Nicolescu (2002); Max-Neef (2005); McGreror (2004, 2008)

# *Finally* ... bridging the gap between

## complexity practitioners & scientists ...



- mutual transdisciplinarity
  - capacity to “think out-of-the-box”
  - coping, not solving dilemmas Rittel et al. (1973)
  - dynamic, mutual adaptation – alignment (ANT)
  - institutional diversity & development  
Ostrom (1999, 2005)
  - the paradox of (social) theory Flyvbjerg (2001)
  - ‘community of practice’ Wenger (1999)

→ joint learning-by-doing

# References (1)



Argyris, Chr., and D.A. Schön (1974). *Theory in practice: Increasing professional effectiveness*. San Francisco Cal.: Jossey-Bass.

Callon, M. (1986). Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of Saint Brieuc Bay. In *Power, Action and Belief: a new Sociology of Knowledge?*, J. Law, Ed., 32nd ed. London: Routledge, pp. 196-233.

Callon, M. (2007). What does it mean to say that economics is performative? In *Do economists make markets? On the performativity of economics*, D. MacKenzie, F. Muniesa, and L. Siu, Eds. Princeton: Princeton University Press, pp. 311-357.

# References (2)

- Cozzens, S., Regan, P., and Rubin, B. (2008). Final Report NSF Workshop on Social Organization of Science and Science Policy (July 13-14, 2006). National Science Foundation (NSF).
- Easton, D. (1957). An Approach to the Analysis of Political Systems. *World Politics*, Vol. 9 (3): 383-400.
- De Man, W. H. E. (1988). Establishing a geographical information system in relation to its use; a process of strategic choices. *Int. Journal of GIS*, 2(3), 245-261.
- De Man, W.H.E. (2000). Institutionalization of Geographic Information Technologies: Unifying Concept? *Cartography and GIS*, Vol. 27 (2).
- De Man, W.H.E. (2006). Understanding SDI; complexity and institutionalization. *IJGIS*, Vol. 20 (3).



# References (3)



- Ferraro, F., Pfeffer, J., & Sutton, R. I. (2005) Economics Language and Assumptions: How Theories Can Become Self-Fulfilling. *Academy of Management Review*, 30 (1), 8-24.
- Flyvbjerg, B. (2001). *Making Social Science Matter. Why social inquiry fails and how it can succeed again*. Cambridge University Press, Cambridge UK.
- Galilei, G. (1962, 1632). Dialogue Concerning the Two Chief World Systems. S. Drake, translator, University of California Press, Berkeley Cal.
- Giddens, A. (1984). *The constitution of society: outline of the theory of structuration*. University of California Press, Berkeley Ca.

# References (4)



- Granovetter, M. S. (1973). "The Strength of Weak Ties." *The American Journal of Sociology*, 78(6), 1360-80.
- Hajer, M. A., and Wagenaar, H., Eds., (2003). *Deliberative policy analysis; understanding governance in the network society*. Cambridge University Press, Cambridge, U.K.
- Hilhorst, T. (2004) Complexity and Diversity: Unlocking Social Domains of Disaster Response. In *Mapping vulnerability; disasters, development and people*, edited by G. Bankoff, G. Frerks, and D. Hilhorst (London: Earthscan), pp. 52-66.
- Kwa, C. (2002). Romantic and Baroque Conceptions of Complex Wholes in the Sciences. In *Complexities; Social Studies of Knowledge Practices*, J. Law and A. Mol, Eds. Durham: Duke University Press, pp. 23-52.



# References (5)



- Latour, B. (2005). *Reassembling the Social. An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.
- Landau, M. (1969). "Redundancy and the problem of duplication and overlap." *Public Administration Review*, 29, (4), 346-58.
- Landau, M. (1973). "Federalism, Redundancy and System Reliability." *Publius*, 3(2), 173-96.
- March, J.G. & Olsen, J.P. (1984). *The New Institutionalism: Organizational Factors in Political Life*. *The Amer. Pol. Sc. Rev.* 78(3): 734-749.
- Law, J. (1992). "Notes on the Theory of the Actor-Network: Ordering, Strategy and Heterogeneity." *Systemic Practice & Action Research*, 5(4), 379-93.

# References (6)



March, J.G. & Olsen, J.P. (1984). The New Institutionalism: Organizational Factors in Political Life. *The Amer. Pol. Sc. Rev.* 78(3): 734-749.

Masser, I. (1980). The Limits To Planning. *Town Planning Review* 51 (1): 39-49.

Max-Neef, M.A. (2005). Foundations of Transdisciplinary, Ecological Economics, Vol. 53, 5-16.

McGregor, S.L.T. (2004). The Nature of Transdisciplinary Research and Practice.

[www.kon.org/hswp/archive/transdiscipl.html](http://www.kon.org/hswp/archive/transdiscipl.html)

McGregor, S.L.T. (2008). Positioning Poverty Within Transdisciplinarity.

[www.consultmccgregor.com/documents/keynotes/malt](http://www.consultmccgregor.com/documents/keynotes/malt)

# References (7)



- Mitleton-Kelly, E. (2004), “Ten principles of complexity and enabling infrastructures”, in Mitleton-Kelly, E. (Ed.), *Complex Systems and Evolutionary Perspectives on Organisations*. Pergamon, London, 23-50.
- Mol, Annemarie & John Law (2002), *Complexities: An Introduction*. In *Complexities; Social Studies of Knowledge Practices*, edited by J. Law and A. Mol (Durham: Duke University Press), pp. 1-22.
- Nicolescu, B. (2002), *Manifesto of Transdisciplinarity*, Albany: State University of New York Press.
- Orlikowski, Wanda J. (1992), The Duality of Technology: Rethinking the Concept of Technology in Organizations, *Organization Science*, 3, 3: 398-427.

# References (8)



- Ostrom, E. (1999). "Coping with tragedies of the commons." *Annual Review of Political Science*, 2, 493-535.
- Ostrom, E. (2000). The danger of self-evident truths. *PS: Political Science and Politics*, 33 (1): 33-44.
- Ostrom, E. 2005. *Understanding institutional diversity*. Princeton, NJ: Princeton University Press.
- Pinch, T. (1990). The Culture of Scientists and Disciplinary rhetoric. *European J. of Education*, 25 (3): 295-304.
- Rittel, H. & M. Webber (1973). Dilemmas in a general theory of planning. *Policy Sciences*, 4: 155-169.

# References (9)



- Rosenhead, J. (1980a). "Planning Under Uncertainty: 1. The Inflexibility of Methodologies." *The Journal of the Operational Research Society*, 31(3), 209-16.
- Rosenhead, J. (1980b). "Planning under Uncertainty: II. A Methodology for Robustness Analysis." *The Journal of the Operational Research Society*, 31(4), 331-41.
- Simon, H. A. (1981). *The sciences of the artificial*, MIT Press, Cambridge MA.
- Schön, D. A. (1987). *Educating the reflective practitioner. Toward a new design for teaching and learning in the professions*. Jossey-Bass, San Francisco, Ca.

# References (10)



Star, S.L. (1999). The ethnography of infrastructure. *American Behavioral Scientist*, 43 (3): 377-91.

Star, S. L. (2002). Infrastructure and ethnographic practice. *Scandinavian Journal of Information Systems*, 14(2): 107-122.

Tacchi, J., Slater, D. & Hearn, G. (2003). *Ethnographic Action Research: a User's Handbook*. UNESCO, New Delhi.

Tress, B., G. Tress, A. Van der Valk, and G. Fry (Eds.) (2003). *Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations*, Wageningen: Alterra, Landscape Centre.

Tuchman, B. W. (1985). *The March of Folly: from Troy to Vietnam*. (2nd ed.). Abacus, London.

# References (11)



Wenger, E. (1999). *Communities of Practice: Learning, Meaning and Identity*, Cambridge University Press, Cambridge, UK(1999).

Williamson, O.E. (1998). Transaction Cost Economics: How it works; where it is headed. *De Economist*, 146 (1): 23-58.