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Scientific Evolution, Regional Science and new Multidisciplinary Approaches

Lecture at the 40th European Congress, Barcelona, Spain,
August 29 – September 1, 2000, European Regional Science Association

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Abstract

It is evident that a modern and dynamic industrial civilisation undergoing continual development generates a constant requirement for political steering and problem-solving which, however, must have a sufficient theoretical basis if it is to be efficient. Consequently science finds itself confronted with the problem of supplying adequate answers to the constantly emerging and already-known – but as yet unsolved – key problems of the industrial society, e.g. ecologic-economically connected problem areas. Thus the classical individual sciences are frequently out of their depth when faced with problems reaching beyond their own disciplines. As theories gleaned from individual sciences are often in no adequate position to record and explain complex problems in way concurring with reality, the central theme of the question is, therefore, whether the mono-disciplinary research strategy which has been dominant to date should/must be enhanced by a multidisciplinary nature – also, and particularly, with regard to regional science. For it is the key task of science to provide secure knowledge about the environment and the mechanisms of its functionality. This is being made more difficult at present, as the problem constellations to be solved by science do not adapt themselves to each of the historically grown disciplinary boundaries. They make it necessary for both scientific disciplines and individual researchers to keep an open mind for questions which go beyond on single subject.

Three theses are important: Ecological Regional Planning is a moulding process

– of various, interwoven non-linear dynamic systems
– whose key problem areas show that an interwoven interaction of various sciences is necessary

– which only efficiently creates new system structures if it succeeds as rapidly as possible in breaking up antiquated modes of thought and to dispense with “territorial behaviour” specific to any one subject – both in theory and in practice.

The following is therefore an investigation into whether newer approaches to research possess a suitability profile which opens up the possibility of multidisciplinary co-operation and promotes innovative problem-solving.

With regard to the question to be discussed here, multidisciplinarity is the problem-induced integration of knowledge, methods and instruments from other sciences in order to solve complex tasks.

Four quite new approaches to research will be analysed below from this perspective:

– Artificial intelligence research
– Artificial life research
– Virtual reality research
– Chaos research.

1. Basic problems

It is evident that a modern and dynamic industrial civilisation undergoing continual development generates a constant requirement for political steering and problem-solving which, however, must have a sufficient theoretical basis if it is to be efficient. Consequently science finds itself confronted with the problem of supplying adequate answers to the constantly emerging and already-known – but as yet unsolved – key problems of the industrial society, e.g. ecologic-economically connected problem areas. Thus the classical individual sciences are frequently out of their depth when faced with problems reaching beyond their own disciplines. As theories gleaned from individual sciences are often in no adequate position to record and explain complex problems in way concurring with reality, the central theme of the question is, therefore, whether the mono-disciplinary research strategy which has been dominant to date should/must be enhanced by a multidisciplinary nature – also, and particularly, with regard to regional science. For it is the key task of science to provide secure knowledge about the environment and the mechanisms of its functionality. This is being made more difficult at present, as the problem constellations to be solved by science do not adapt themselves to

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2. New Approaches to Research

With regard to the question to be discussed here, multidisciplinarity is the problem-induced integration of knowledge, methods and instruments from other sciences in order to solve complex tasks.

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2.1 Artificial Intelligence Research

Although this discipline has over the last few years lost a little of the euphoria which still surrounded it in the mid-1980s, a promising instrument results from it – expert system technology – which is able to provide constructive and innovative concepts for complex inter-connected problems such as must be methodically solved by regional science. The proposed solutions from expert systems can gradually compete with those of human experts, at least within certain limited areas of knowledge. Such systems possess a database relating to a certain specialist area, a basis of knowledge, consisting of coded rules, which draws conclusions and a fast deduction mechanism which systematically applies the rules to the current problem.

Expert systems open up the following spectrum of application:

- Simplification of the provision and administration of comprehensive bases of information and knowledge, e.g. with regard to ecosystem structures, the often interwoven patterns of economic use as well as the legal regulations which must be observed.

- Guarantee of access possibilities to knowledge and experience of experts from different scientific disciplines who are not currently present.

- Improvement of the informational foundation of concepts, e.g. of ecological regional planning by means of:

    - a locally independent accumulation of knowledge

    - the integration of knowledge from various experts in connection with the necessary adaptation and clarifying of inconsistencies

    - a duplication of knowledge and conservation

    - an eradication of the need to permanently re-analyse/re-evaluate solution concepts.

It therefore follows that the application of current expert systems within ecological regional planning is primarily aiming at a qualitative improvement of information systems

and processes, as specialist knowledge relevant to a problem can be both stored on a long-term basis and is available at all times.

The result of this is that the expert system technology represents a new innovative approach to overcome the interconnected problems which occur.

2.2 Artificial Life Research

In complex systems, e.g. the ecosystems of a landscape, individual elements interact according to such complicated mechanisms that their patterns of behaviour cannot be predicted using linear standard equations. For regional science it therefore follows that it makes little sense to base such moulding processes on simplifying approaches. If these are to be efficient, the attempt must be made to analyse and understand the complexity potential which occur. For this purpose, a young scientific discipline, artificial life research, which emerged in the 1940s, provides promising instruments. For in regional planning in particular the observation of a larger area, and not merely the concrete question, often leads to a much better understanding of the problem to be solved.

The object of research in the artificial life approach are the life-forms generated by experts in the computer which develop according to the laws of natural life. The growing understanding of ecological effect mechanisms in connection with the increasing performance of modern computers is increasingly putting research in a position to copy the masterpiece of nature: living systems.

Artificial life is devoted to the shaping and research of lifelike organisms and systems created by man. The nature of this material is inorganic, its core is information and computers are the incubators which bring forth these new organisms. Just as medical research has managed to create the processes of life partly in test tubes (in vitro), biologists and computer specialists hope to create life in silicon chips (in silicio).

Artificial life scientists are pondering the possibilities – and the resulting starting-points for ecological regional planning – of generating, developing and observing living systems which are as isomorphic as possible to those in the real environment. There have been attempts to influence the course of evolution for many living systems on the earth and

beyond. This great experiment could not only lead to a deeper understanding of life as a whole, but could also provide a possibility to use its mechanisms to assume part of our work. This might even lead to the discovery of powerful laws of nature which not only govern biological but also every kind of complex, non-linear, self-organising system.

Artificial life research, which allows us to see a "post-biological" future on the horizon, could contribute to improving the understanding of ecological systems and thereby expand the spectrum of possibilities, e.g. ecological regional planning based on simulation calculations. The results will then be analysed by complex instruments in such a way that is not possible in reality. Based on these results, statements about environmental influences on ecosystems can be derived without really having an adverse effect on them. Consequently this can bee seen as a research-strategical opportunity potential which regional science should not leave unused. However, the prerequisite for this is a willingness for multidisciplinary co-operation.

2.3 Virtual Reality Research

As the world in which man lives is continually increasing in complexity and its individual systems – natural environment, economy, society – are affecting each other to an increasing degree, decisions, also those in regional science, for example, are becoming more difficult and have wider-ranging consequences.

In the future the primary research and problem-solving instrument will most likely be the computer. Although it has in the past already fundamentally altered the picture scientists have of material reality, virtual reality research might open up completely new dimensions. Virtual reality (VR) is very practical. It turns the traditional computer – which is utilised today as an appliance with which to process numbers and letters – into a machine which generates its own virtual reality. Scientists and computers are at the threshold of a symbiotic relationship.

VR is an instrument for visualising and modelling which contributes to conceiving plans and developing concepts in order to meet the challenges of dynamically changing

systems. VR makes three-dimensional real time simulations possible which the researcher as an interactive participant can manipulate and alter in many ways.

Apart from the approaches to research already mentioned above – artificial intelligence research and artificial life research – which are becoming increasingly interwoven with the virtual reality approach so that not only the technical possibilities improve, but also in all probability their spectrum of applications in various scientific systems, virtual reality research is already providing instruments today which appear to be of use for practical work such as regional planning. For VR enables us to explore a computer-generated landscape by moving about in it. Instead of sitting in front of a screen or a map, the planner responsible for land development, for example, is integrated into a three-dimensional graphical environment in which he can influence what happens to this virtually generated landscape when he employs certain measures of shaping to bring about the development.

With regard to the development and use of VR research for the problem described here, we can safely say: today's theory is literally tomorrow's reality. Even if the systems are not yet in a status nascendi, it may be assumed that the technology will develop according to an exponential pattern of growth so that any deficits should be eliminated in the medium term. Virtual reality research will in future provide regional science with a wide spectrum of application which will contribute towards developing new, innovative concepts. The promising methodical possibilities of VR lie less in a reproduction – as true to nature as possible – of exterior physical reality than in the simplification of navigation and the visualisation of abstract data. In the long run VR should turn out to be the most powerful instrument for mastering the flood of data which is becoming ever more complex.

2.4 Chaos Research

The above approaches to research will bring about the elimination of deficits in models and instruments currently being used, as planning models for the re-development of land and property will be shaped more realistically. Current models succeed only partly in recording – with particular emphasis on specific problems – the

interwoven nature of various elements and processes which occur in complex systems, with the consequence that the way they model actual structures is insufficient.

Chaos research is also giving innovative impetus. Planning, which precedes development, has the function of preparing future actions. Several alternatives must thereby be strategically considered and held in readiness. In the end only one of the alternative actions will be carried out. Due to the uncertainty of non-linear systems assumed in chaotic processes, it is not possible to make clear forecasts.

Non-linear models no longer model all the individual causal chains but knots in which feedback loops interconnect. The goal is not a forecast but to disrupt the model by varying the parameters, thereby learning something about the critical points of the system and about its capability for resistance.

Analogies of the working mechanisms from the perspective of ecological regional planning show that relationships do exist which means that the chaos-theoretical approach in regional science certainly comes into its own. It was of course possible to give plausible reasons for development processes before now. In this way, for example, the necessity for development measures was derived from the ageing process of extremely interwoven systems without the ability to regenerate themselves.

Does the system not react to redistribution so sensitively at the point of bifurcation that old crusts break open to new possibilities ? To each decision made at the branching point belongs the strengthening of something very tiny by iteration. Strengthening small fluctuations is the lever to creativity.

Through phase locking, i.e. if many individually oscillating systems (= participants in the process) couple – through fixed-phase coupling – out of a state of chaos to a common oscillation, unfolding a group rhythm, dreams can create new realities.

The investigation of chaos and its working mechanisms strengthens the initial theory of a holistic approach, e.g. within ecological regional science. In this context the chaos theory provides new patterns of thought and research whose potential should not remain unused.

3. Summary

Based on the above it is evident that the approaches examined are in a position to give models of regional science, innovative impulses concerning their conceptual further development so that the complexity of reality will be taken into consideration more than in the past.

The prerequisite for this is the willingness to enter into multidisciplinary co-operation. Today, when almost all problems are intertwined with one another, multidisciplinarity is not only a desideratum of theoretical reason, but a part of a strategy for survival. Every scientific discipline must realise a permanent dialogue and transfer of information with other disciplines which are relevant to the problem in order to be able to make the latest level of research knowledge its own.

The task of this contribution was to show which streams of research it makes sense to enter into dialogue with - even if many of these are still in the so-called "teething" phase. But the development of science in modern times is taking a more exponential than linear course, which is why thrusts of innovation - and thereby the accompanying progress of knowledge - contribute to diminishing the faults which can still be recognised.

Regional science must be able in future to feel its way into the patterns of thought of other disciplines with a high degree of sensitivity, thereby respecting the ways in which these are different: the colleague from another field is not a projection screen of one's own shortcomings, nor a symbiotic substitute for a part of oneself, nor an object for the egotistical satisfying of one's needs.

In the near future regional scientific research will be taking place according to completely new schemes. Furthermore, its instruments will be changed both qualitatively and quantitatively.

Literature

D. Fliedner
Komplexität und Emergenz in Gesellschaft und Natur, Frankfurt/M. et al. 1999.

B. Gräfrath/R. Huber/B.Uhlemann

Einheit, Interdisziplinarität, Komplementarität, Berlin – New York 1991.

R. Kurzweil

KI - Das Zeitalter der Künstlichen Intelligenz, München – Wien 1993.

G. Leidig

Raumplanung als Umweltschutz, Frankfurt/M. et al. 1983.

G. Leidig

Ökologisch-ökonomische Rechtswissenschaft, Frankfurt/M. et al. 1984.

G. Leidig

Aspekte einer Ökologisch-ökonomischen Rechtswissenschaft, in: Universitas 39 (1984), H. 7, p. 759 pp.

G. Leidig

Interdisziplinarität und Wissenschaftsentwicklung, in: J. Klawitter/R. Kümmel/G. Maier-Rigaud (Hrsg.), Natur und Gesellschaft, Berlin et al. 1990, p. 183 pp.

G. Leidig

Bodenschutz. Gegenstand interdisziplinärer Forschung, Frankfurt/M. et al. 1990.

G. Leidig

Interdisciplinary research, in: D.B.S. Fitch/A. Pikalo (Hrsg.), Soziale und ökonomische Aspekte der Bodennutzung, Frankfurt/M. et al. 1990, p. 7 pp.

G. Leidig

Ökologische Raumplanung als Multidisziplinarforschung, in: Umwelt- und Planungsrecht 1992, H. 8, p. 294 pp.

G. Leidig

Expertensystembasierte Bodenschutzpolitik, in: A. De Leeuw/H. Priemus (Hrsg.), Bodenpolitik und Infrastruktur, Frankfurt/M. et al. 1993, p. 223 pp.

G. Leidig

Research Strategies in a Time of Change, in: G. M. Schinas/P. Trappe (Hrsg.), Gesellschaftssysteme im Umbruch, Frankfurt/M et al. 1995, p. 45 pp.

G. Leidig

Rechtswissenschaft im Wandel: Aspekte eines ökologisch-ökonomischen Ansatzes, in: G. M. Schinas/P. Trappe (Hrsg.), Gesellschaftssysteme im Umbruch, Frankfurt/M. et al. 1995, p. 53 pp.

G. Leidig

Chaosforschung und Umweltschutz, Basel 1995.

G. Leidig

Rechtsökologische Forschung und Chaostheorie, in: Zeitschrift für öffentliches Recht 52 (1997), H. 1, p. 127 pp.

G. Leidig

Chaostherorie und Zukunftsherausforderungen, in: Ch. Bosshardt (Hrsg.), Problembereiche interdisziplinärer Forschung, Bern et al. 1999, p. 77 pp.

G. Leidig

Ecological land development and multidisciplinary research, in: R.W. Dixon-Gough (Hrsg.), Land Reform and Sustainable Development, Aldershot et al. 1999, p. 43 pp.

S. Levy

KL – Künstliches Leben aus dem Computer, München 1993.

J. Radkau

Natur und Macht, München 2000.

H. Rheingold

Virtuelle Welten, Reinbek bei Hamburg 1995.

B. Sherman/P. Judkins

Virtual Reality, München 1995.

H. Spindler

Die Umwelt und die Zukunft des Menschen. Eine Philosophie der Umwelt, Hanau 1996.