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Zürich, August 30, 2008

Dear sponsor,

herewith, I would like to provide a short report about the international workshop on *Challenges and Visions in the Social Sciences*, which took place from August 18-23, 2008 at ETH Zurich. The workshop was financially supported by the EU Framework Program 6 through the project GIACS and by the ETH Foundation. It was organized by Dirk Helbing (coordinator), Lars-Erik Cederman, Andreas Diekmann, Frank Schweitzer, and Didier Sornette.

Based on the unexpectedly large number of contributions on social systems and networks during the *European Conference on Complex Systems 2007 (ECCS'07)* in Dresden last year, the related report concluded: "*It is remarkable that "Social Systems" attracted so many contributions despite of the difficult funding situation in this field. This indicates the emergence of a new focus of research in the complex systems community (after physics and biology have played this role in previous decades). It is, therefore, recommended to consider this development in future calls for proposals, in particular as a better understanding of socio-economic systems is much needed, both due to a noticeable lack of tested theories and the increasing number of socio-economic problems in our globalized world, for which solutions are urgently required.*"

It was, therefore, a necessary step to come up with an international workshop on *Challenges and Visions in the Social Sciences*. Social and economic systems show all typical features of complex systems, among them the non-linear interaction of a huge number of entities and variables, adaptiveness, emergence, a variety of self-* properties, in particular self-organization and self-repair, and the unexpected sensitivity to small parameter changes under *some* conditions, while behaving robust most of the time. Related research fields are phase transitions, critical phenomena, and others. Particularly important issues are structure and network formation. Computer based models in the rapidly growing social simulation community often use agent-based models, but also partial differential equations, stochastic equations, and other methods. Moreover, models of socio-economic systems are increasingly tested and created by means of empirical and experimental data (e.g. in experimental game theory). This requires reliable statistical methods and resource-intensive experimental setups.

As a consequence, the workshop on *Challenges and Visions in the Social Sciences* wanted to gain a better understanding of socio-economic systems as complex adaptive systems and to identify questions, methods, and instruments to make a substantial scientific progress in this area in the future. Specifically, by means of keynote talks and interdisciplinary discussions, the workshop aimed at identifying future trends in the social sciences, and problems that will have to be addressed. We hoped to come up with visionary ideas of what will be the important topics over the next 10 or 20 years, and try to formulate a list of hard, ambitious, and important problems to be addressed by collaborative, international research projects. Contributions could be methodologically or problem oriented, but should always be of interest to a wider scientific community.

The following are some of the subject areas the workshop focused on:

- Empirical challenges
- Methodological challenges
- Practical challenges

The meeting combined elements of an interdisciplinary workshop with a think tank and a summer school for junior scientists, consisting of tutorials. Further information is available on the webpage [/www.soms.ethz.ch/workshop2008](http://www.soms.ethz.ch/workshop2008).

Some Statistical Data

The workshop was originally planned for 60 participants. The considerably larger number of almost 100 participants shows the great interest in the subject. About 55% of the participants were from the social sciences and the rest from the natural and engineering sciences. This was of particular importance for a balanced and open interdisciplinary exchange, while previous interdisciplinary workshops often had a majority of people from one discipline.

The registered participants came from as much as 28 different countries: About 45% of participants were from Western Europe (excluding Switzerland), and more than 10% from Eastern Europe. More specifically, 25% from Switzerland as the host country, 18% from Germany, 13% from the USA, 12% from the UK, 6% from Spain, 5% from the Netherlands, 4% from Italy, 3% from France, 3% from Japan, 3% from Canada, 3% from Turkey, 2% from Hungary etc. Asian, African, and South-American countries were represented as well. It was very remarkable how mixed the audience was across countries and disciplines, and that the leading research institutions like the University of Oxford, for example, had sent representatives to the workshop.

Organizational Concept

All participants were extremely positive about the workshop and characterized it as an exceptional event. The success of the workshop could build on the organizational concept developed for the *European Conference on Complex Systems 2007 (ECCS'07)* in Dresden. Already there, we had combined different instruments and formats (such as keynote and contributed talks, posters and Satellite Conferences). In the following, we will list some of the main success factors in detail:

1. **Keynote speakers** have been determined by identifying the international scientists with the greatest impact in their field. These speakers were contacted more than one year ahead of the workshop, referring them to webpages of previous successful conferences and colloquia. Moreover, confirmations of speakers were immediately publicized on the conference webpage, so that people eventually saw who the other confirmed speakers of the workshop were. The more confirmations we had, the more likely was the chance that other invitees would commit themselves as well to give a keynote talk, considering the large reputation of the speakers.
2. **Contributed talks** could be easily attracted based on the impressive list of the keynote speakers, which read like an international Who is Who. Due to the large number of submissions, we had to convert some of the requests for contributed talks into poster contributions.
3. **Poster contributions** are an important, but potentially critical issue of this kind of workshops, as many people prefer to give a talk, while parallel sessions are often frustrating for both, speakers and audience. We have, therefore, announced a best poster award, which was an incentive to participate in the workshop even if we could accept only a poster contribution. In the end, we had about 30 posters. The best poster award made sure that most people created didactically well prepared posters, which attracted the interest of the audience.
4. **Best poster talks** could be presented by the authors of the four best posters selected by the keynote speakers. These were the posters
#3 by Michael Maes, Andreas Flache, Hanne Visser: "What on Earth Must We Assume..."
#7 by Lin Lin, Thomas Lux: An Agent-Based Model of Employment, Production, and Consumption

- # 25 by Matus Medo: Breakdown of the Meanfield Approximation in a Wealth Distribution Model
- # 30 by Maximilian Schich, Sune Lehmann, Juyoung Park: Dissecting the Canon: Visual Subject Co-Popularity Networks in Art Research

The first poster falls into the area of sociology, the second in the area of economics, the third into the area of econophysics, and the last one into the history of arts, using a computer science approach. In the end, the audience determined posters number 3, 25, and 30 as the best three posters, and the nominated junior scientists (first authors) received a best poster award document, associated with a prize of 1,000 CHF each. Apart from this, the selected oral presentations gave junior scientists the opportunity to present their work in front of the plenary audience. The high level of the presentations shows that there are currently a number of excellent junior scientists in the field covered by the workshop, for which the research community will eventually have to find permanent positions for.

5. **Tutorials** usually extended over several sessions (many hours) and served to give junior scientists the opportunity to get a detailed and thorough introduction into important methods. The list of tutorials was as follows:

- Douglas Heckathorn: Respondent-driven sampling
- Anders Johansson: Simulating the dynamics of human crowds
- Pietro Speroni di Fenizio: Observing society through tags: Using tags to help society
- Jörg Reichardt: Network analysis: A physics perspective
- Dirk Helbing: Mathematical modeling of behavioral changes by pair interactions

6. **Think tanks** were held in the evenings, each after an evening talk. On altogether four evenings, the following subjects were covered:

- Empirical and Experimental Challenges
- Modeling and Simulation Challenges
- Practical Challenges
- Challenges of Interdisciplinary Research

It turned out that, despite the late time of the day, after long workshop days, people participated in the think tanks in large numbers, even on Friday evening. The discussion was organized into a panel composed of about 6 to 8 keynote speakers and organizers, which the audience could ask question to, or make own comments. This concept worked extremely well. There was a good balance between contributions from the audience and from the panel, and between the different disciplines represented at the workshop. The think tanks fully reached their goal of initiating an intensive and, at times, controversial brain storming. In fact, the participants found the tutorials extremely useful and inspiring, and the discussions were often continued during common dinners.

7. **Communication opportunities** were not only created by think tanks, but also by the posters in the foyers, sufficient coffee breaks, a social dinner, and common lunches. Furthermore, we made reservations of tables for common dinners with the keynote speakers. Although everybody had to pay by himself or herself (apart from the social dinner during the boat trip on Wednesday), this stimulated a lot of additional discussions and triggered several plans for future publications and projects across countries and disciplines.

8. **Video recordings** were made of most keynote talks and think tank discussions (if speakers or participants did not object against it). These will be made freely accessible at www.videlectures.net for those people who could not participate in the workshop for one reason or another. The considerable number of video downloads from the ECCS'07 conference webpage (see www.trafficforum.org/dresden) shows that there is a need for such a service, which some people have explicitly requested. It is expected that this service will efficiently support the interdisciplinary communication across communities.

9. **Financial support** was needed to cover the costs of the workshop (see the separate financial report). The majority of keynote speakers got their accomodation and travel costs covered (mostly economy class). One (oversized) speaker required business class travel, and another one received a honorar-

ium rather than a reimbursement of the travel costs.

As the funding situation in the social sciences is still critical altogether, it was also necessary to support 10 of the speakers by providing them with free accommodation. These participants were selected based on the quality of their contributions, but with a preference regarding representatives of new European member states and female scientists, in order to contribute to the implementation of some of the goals of the EU.

It was the combination of these different issues, which made the workshop a particularly great success. Maybe the best proof of this was the high level of participation, even in the evenings (until 19:30) and towards the end of the week, including the tutorial on Saturday. The large interest of the audience was very impressive.

Future Challenges

In the Think Tanks, the following problems have been discussed:

- **Empirical Challenges**

- Data sociologist would like to have
- Measurement techniques
- New data sources
- Evaluation methods
- Data mining vs. hypothesis-driven approach
- Software tools
- Privacy and ethical issues

In conclusion, thanks to new technologies, experimental techniques, and statistical methods, a large amount of data of social systems and behavior is getting available at present or in the future. This includes data from the Web 2.0, neural imaging data, combinations of data from surveys with behavioral experiments and/or biological data. Therefore, a data-driven modeling may become feasible in the future, but the issue of privacy must be paid particular attention to. Furthermore, it will still remain a challenge to find the data required to construct a social theory systematically. This requires data of social behavior over time *and* of the social contexts of the interacting individuals. In order to obtain such data sets, one will need massive efforts to match different data sets or to measure social behavior on a much larger scale. While such research will definitely be needed, one will have to provide sufficient funding for this and to find proper ways to consider privacy issues.

- **Modeling and Simulation Challenges**

- Fundamental subjects
- Constituting elements and relations
- Parameter calibration
- Correlation and causality
- Predictive power
- Realistic vs. toy models
- Stylized facts
- Universal behavior
- Artificial societies

Computer simulation in the social sciences is eventually progressing and spreading. However, one problem is still that computer programming is not part of the standard social science education. Sometimes, this has also led to faulty implementations of models and wrong conclusions. As a consequence, the acceptance of agent-based models in the social sciences is still not satisfactory. Therefore, it has been decided to write a guide for how to properly set up and test agent-based models and how to calibrate them. One particular challenge is to bring simulation models and em-

pirical data together.

- **Practical Challenges**

- Globalization
- Individualization
- Aging societies
- Environmental pollution and global warming
- International conflicts
- Understanding instabilities and crises
- Sources of disequilibrium and regime shifts
- Decision support

Altogether, the social sciences do not seem to be prepared well to make concrete advice to politicians and business representatives when it comes to address current and upcoming problems, while the analysis of past events is much better. This situation is a consequence of the lack of a reliable social theories that could be applied to scenarios which have not occurred before. Moreover, in contrast to mathematics and some natural sciences, it seems to be uncommon in the social sciences to study systems that currently do not exist, while this could potentially be done within the field of artificial societies. Therefore, it is difficult to address questions like “What would happen, if ...”. This also implies that there are little attempts in terms of mechanism design, i.e. the creation of new social mechanisms and institutions, which could also be called “social engineering”. One of the reasons for this could be objections against engineering in the social sciences.

- **Challenges of Interdisciplinary Research**

- Terminology
- Problem classification
- Networking and cooperation
- Funding
- Information exchange
- Publication
- Innovation speed

While in the past, the different approaches of different scientific disciplines made it even difficult to communicate with each other, the situation seems to have considerably improved, which reflects the ongoing dialogue between the disciplines. Still, a general agreement on the right methodology (e.g. whether to build models with many or few parameters, or whether to use mathematical or computational models at all) has not been reached. This disagreement poses particular challenges to interdisciplinary publications and projects. Most of the time, they are not evaluated by scientists with a background in two disciplines, but by mono-disciplinary experts with often incompatible conceptions of how good science should look like. As a consequence, the success rate of interdisciplinary scientific attempts is lower, or the required effort to get projects funded or papers published is much higher, which makes interdisciplinary careers very risky. The most promising approach at present seems to form project teams with members from different disciplines, and to publish together. However, the funding system does not provide enough opportunities for the funding of large, interdisciplinary research projects yet. This applies particularly to national funding schemes for the social sciences. On a medium-term perspective, it will be necessary to have own interdisciplinary journals with a sufficiently high impact and publication speed, and to have enough referees with backgrounds in two or more disciplines, in order to reach a fair evaluation and fair career opportunities for junior scientists.

Summary

In summary, there seems to be a regime shift in the social sciences. Collaborations with other disciplines start to take off, and the availability of powerful empirical, experimental and simulation techniques will allow for scientific breakthroughs that were unconceivable for the social sciences in the past. Such breakthroughs are also urgently needed to address the practical challenges that human societies are facing. Considering an anticipated loss of 1,000 billion US dollars due to the current financial crises, it would have been much cheaper to invest 1% of this amount into the scientific study of socio-economic systems. Without any doubt, world-wide research investments of a considerable order of magnitude are needed to avoid and cope with future social and economic crises. If we would invest sums of money into the social sciences of the order spent on elementary particle physics, we would know much better what the mechanisms of economic growth, financial stability, and social conflicts are, to mention just a few subjects. In some sense, it is not understandable that we require each technical device and each medical drug to undergo a long and expensive testing procedure, while we apply mechanisms in socio-economic systems, which are neither properly understood nor tested. Considering the enormous implications for the lives and social well-being of humans, this is beyond what science could do for our societies today and in the future.

For this reason, a follow-up workshop on *Coping with Crises in Complex Socio-Economic Systems* will be held in Zurich next year, see www.soms.ethz.ch/workshop2009 .

Acknowledgments

I would like to thank

1. the EU Framework Program 6 (namely, the project GIACS) and the ETH Foundation for financial support,
2. the keynote and contributed speakers and poster presenters, as well as the participants who have contributed to the success of the think tanks and discussions,
3. the coorganizers of the workshop and my research team, who supported me in a phantastic way,
4. the team of www.videlectures.net for documenting the workshop, and
5. ETH Zurich for providing rooms, internet services, food, and technical support.

A financial report will be sent separately after the accounting has been completed.

Sincerely yours,

Dirk Helbing