

Handout for the seminar *Systems Science*

Hans-Gert Gräbe, Ken Pierre Kleemann, Lydie Laforet, Sabine Lautenschläger

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1 Aim and methodology of the seminar

The concept of system plays a prominent role in computer science when it comes to database systems, software systems, hardware systems, accounting systems, access systems, etc. In general computer science is regarded by a majority as the "science of the *systematic* representation, storage, processing and transmission of information, especially the automated processing using digital computers" (Wikipedia). Also certain relevant professions such as *system architect* are held in high esteem by IT users.

However, the importance of the concept of system extends far beyond the field of computer science – it is fundamental for all engineering sciences and as *Systems Engineering* with the ISO/IEC/IEEE-15288 standard "Systems and Software Engineering", it is also the subject of international standardisation processes. Even more, the concept of systems also plays a role in the description of complex natural and cultural processes – for example in the concept of an *ecosystem*.

With the *Semantic Web*, the analysis of the meaning of digital artefacts becomes central, which are ultimately language artefacts and thus also directly related to a meaningfully unfolded *concept of a system* as basis of any understanding of concrete systems.

The keyword *Sustainability* finally refers to complex social processes of coordination are addressed, which are accompanied by many information and evaluation problems. Here the ability of the descriptive delimitation, development and control of so-called systems on or across different governance, spatial and temporal levels is of great importance.

The objective of the seminar is to gain a better understanding of this diversity of systemic concepts and to *different system theories* as the subject of a *Systems Science*.

The seminar is an introductory course to systems science at the Master's level, its development over time, ramification of approaches, key terms and concepts. *Systems Science* is used here as an term for a field that numerous scholars from a wide range of disciplines such as anthropology, biology, chemistry, ecology, economics, mathematics, physics, psychology, sociology and others have contributed. Developments such as cybernetics, chaos theory or network analysis and network science can be seen as part of systems science or are at least strongly related to it. Some branches of systems science are even regarded in Germany as new scientific fields with their own rights such as synergetics or complexity science.

These developments have opened up new possibilities for improved analysis and decision-making in scientific, business and political areas. However, we see on a daily basis that in complicated situations, especially in politics and business, simple and direct decision-making processes still prevail, leading to an increase in negative developments when the originally intended effects do not materialise. Any unexpected side effect or counter-action, that render the measures useless are a clear indication that the actors' mental models were incomplete and broader systemic correlations have been neglected. Systems thinking is therefore of particular importance for the transition to a more sustainable society in Germany.

This seminar we will trace the historical development of systems science (in parts) and study relevant basic concepts. Course participants do not adhere to any specific model (such as *system dynamics*), but develop a deeper understanding of systems science and a specific kind of "systemic thinking" that can be used to address sustainability problems more successfully. We achieve this by reading and discussing scientific papers and book chapters.

Students are expected to actively participate in the seminar through seminar discussions, presentations, seminar papers and, last but not least by reading the relevant material. The course participants are asked and encouraged to develop their own approach to the topic of sustainability.

2 Course structure

The course is held weekly according to the published schedule in a presentation and discussion format. Each week, seminar participants have to study the assigned reading in advance and be prepared to discuss it in the seminar. After a brief input from the seminar leader the student assigned as *discussion leader* is responsible for moderating the seminar discussion. In preparation for the seminar, *opponents* write short position papers. The participants are expected to either lead the seminar or actively participate in the discussion.

For weeks in which you *lead* the seminar, you

1. have completely studied the reading given for the session,
2. have to prepare a presentation and present it in about 20 minutes as an oral summary of the main points of the session,
3. have to prepare discussion questions to lead a group discussion for about 30 minutes.

For weeks in which you are assigned *as opponent*, you

1. have studied in full the reading specified for the session,
2. have to write a position paper of approximately 800 words (pdf, 11pt, single-spaced) and place it in the materials folder of the seminar.

The presentations and the position papers will (later) be uploaded to github and thus published.

3 Position papers

Each student writes three position papers and leads one seminar discussion. You cannot also write a position paper for the discussion you are leading. The position papers should clearly

reference to the reading material of the respective seminar. In the position papers, students briefly summarise the main points of the reading material and add their own input. These positions can take different forms. They can

- combine the respective theoretical aspect of systems science with questions of sustainable development at large,
- compare or contrast the approach of the author with that of another author who has already been discussed in the seminar, or
- comment on the scope of the seminar topic.

The fulfilment of these performances will not be assessed¹, but is to be considered as prerequisite for admission to the written examination that concludes the module.

4 Literature

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¹We emphasise the academic nature of our project – it is not about evaluating your performance, but about *joint* acquisition of knowledge on a basis of equals.

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