

Within the NEMO-project various aspects of politically induced Innovation Networks are investigated. Besides mathematical approaches also approaches from modern complexity theories will be applied. In particular, an agent-based model of the network dynamics is part of work package 3, where the project teams from Bremen, Dublin and Guildford are working together in the design and implementation of a model with decentralized agents doing research in collaborations and networks. This newsletter is an introduction to the Prototype of the Agent-Based Simulation Model.

SIMULATING KNOWLEDGE DYNAMICS IN EU-FUNDED INNOVATION NETWORKS (SKEIN)

To receive funding from the European Commission, agents have to form a consortium and to present a research proposal. This process, if successful, leads to the formation of EU-funded Innovation Networks in which cooperative research is undertaken and knowledge is mutually exchanged. The SKEIN model developed in NEMO aims to simulate these knowledge-driven network dynamics.

The SKEIN model is a multi-agent simulation, where the actors are public research institutes, universities and private firms. These actors try to apply for research projects within the framework programs of the European Commission (EC) in order to finance their research and to find collaboration partners with complementary knowledge. The aim of our model is to simulate the network dynamics which are going on during the whole process, from the consortium setting up until the presentation of project outputs. Once a group of actors has formed a consortium, the following process starts: (1) a proposal based on parts of the participating actors' knowledge is presented. (2a) If the proposal is rejected the actors try to create a new group and to submit a new proposal in the next period. (2b) If the proposal is accepted the actors receive their funding and start working on the project. (3) Intermediate and final results will be evaluated by the EC during and at the end of the project. (5) The process restarts.

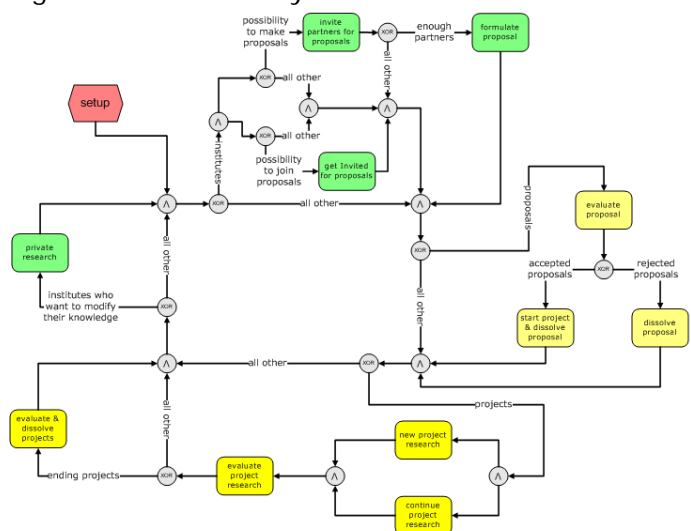


Fig. 1: The structure of the SKIN model. [Pyka A. and Scholz R. (2008), A narrative Description of the Agent Based NEMO-Model, NEMO WP#3]

THE NEMO NEWSLETTER

The objective of the periodic NEMO Newsletter is to provide a platform of interdisciplinary information exchange and discourse for all sciences concerned with complex interorganisational R&D collaboration networks, and to promote the NEMO project worldwide. The Newsletter will offer regular insights into the NEMO project and document its results including previews of NEMO publications.

Other continuous features include the publication of short articles, comments on interesting links, and information about events or publications which are located in the area of our research. External contributions are welcome and should be addressed to the editor. The Newsletter is published quarterly on the NEMO website

<http://www.nemo-net.eu>

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PAPER PREVIEW

The previous newsletters draw a general overview on the results achieved so far by the five NEMO Work Packages. This newsletter aims to briefly present the progresses achieved so far in the development of an agent-based model within Working Package 3. The prototype of the model, called SKEIN (for **S**imulating **K**nowledge **D**ynamics in **EU**-funded **I**nnovation **N**etworks), is running and in the following we will briefly introduce its basic concepts (an extensive explanation of the model is given in a related working paper). Finally, as usual, information on project progresses, recent NEMO publications and recent Meetings will be reported.

WP 3 – SKEIN MODEL: BASIC CONCEPTS

KENES – The knowledge base of each actor is described by a vector containing ‘units of knowledge’ called ‘kenes’. Every kene is composed by quadruples including a capability (C), that is a knowledge area or a technological discipline, an ability (A) referring to the particular capability and the level of expertise (E) acquired in the particular ability, as well as a research direction (RD), i.e. basic or applied research. Actors have two possibilities to expand their knowledge-base: (i) they can undertake research on their own, and (ii) they can cooperate and learn from collaboration partners. Choosing the second possibility, actors build up a consortium and write a project proposal which is submitted to the European Commission (EC).

AGENTS – There are three types of actors in the SKEIN model: R&D divisions of firms, universities and public research institutes. Besides knowledge, actors are characterized by their capital stocks. At the setup of the simulation every actor is randomly assigned with a capital stock. Obviously R&D is a costly activity. Therefore, each actor’s capital stock is reduced by a fixed increment each period and only actors who successfully get a new project receive new financial resources.

PROPOSALS FOR FRAMEWORK PROGRAMME’S – To receive funding for research actors have to form project consortia and cooperatively submit proposals to the EC. The proposals are combination of parts of the members’ knowledge bases. In the selection of their partners, we assume two different strategies for the actors: (i) a *conservative strategy* in which actors’ knowledge base is used to find very similar agents and (ii) a *progressive strategy* in which actors look for very dissimilar partners. The conservative strategy increases the probability of success but also decreases the

potential magnitude of the innovation, due to the low variance of the knowledge pool within the consortium. The progressive strategy leads to a high heterogeneity of the consortium’s knowledge pool, which increases the project output’s innovative potential but also decreases the probability of success. Thus, the success probability and the potential degree of innovation are determined by distances in the kenés of agents. In the ‘proposal writing’ process every actor of the consortium contributes at least one kene element of its current research project.

THE RESEARCH PROJECTS – After being approved, a project starts its work for the accredited amount of time which will be something between 3 and 5 years. During the project the actors in a consortium do cooperatively research and mutually exchange knowledge. We suppose that the kene-elements, combined in the proposal and stemming from different members in the consortium, are randomly re-combined. First, randomly, a number between two and the maximum number of actors in the consortium is chosen. Then quadruples of the selected actors are randomly selected and combined in ‘project hypotheses’. The ‘new combinations’ of quadruples of the proposal are considered to be the project (innovation) hypotheses. This combinatorial process takes place four times for each year the project is running.

With respect to the project outcomes, we use as a simplification the following three types (ranked from the less to the most desired): working papers, articles in journals and patents. To transform a project hypothesis into one of the potential results we apply a transformation function that produces: (i) a number between 0 and 1 which decides on the type of outcome and (ii) a figure describing the success probability of a project hypothesis. The potential outcome depends (a) on the research orientation of actors (the more applied it is, the higher the probability to end up with a patent); (b) on the variance in capabilities involved in the project hypothesis (the higher the variance, the lower the probability to end up with a patent). The success probability depends on: (a) the expertise level of the quadruples of a project hypothesis and (b) the absorptive capacities of the actors. Absorptive capacities are a necessary requirement for the successful integration of external knowledge. For shorter distances in knowledge we assume higher absorptive capacities and vice versa.

The higher these two factors are the higher is the probability of success. Every period the

potential outcome figure is compared with the probability number. If the latter is higher than the former, the respective potential outcome is realized. It is important to note, that actors try to improve the intermediate outcomes, e.g. in the case the project ends up with a working paper, the actors are not satisfied and try to publish an article in a journal, the same hold for journal articles, the actors will try to transform their scientific results into a patentable application.

OTHER RESEARCH – Actors do research not only within consortium's projects, but also on an individual basis. Individual research means that an actor specializes in a subset of its kene quadruples, coming up with own innovation hypothesis. This subset of kene quadruples (the single actor's innovation hypothesis) is visible to other actors and is used to advertise the area of specialization of the actor to other actors; this is of importance for partner search in the formation processes of proposal consortia. Individual research consists of changes in the actor's abilities (incremental research) or in randomly integrating new capabilities (radical research). Individual research plays also an important role in maintaining a certain level of heterogeneity in the knowledge bases of the actors because the knowledge flows in the networks would lead to assimilation in the long run.

NETWORKS – One of the most important activities of an agent is to cooperate with the other actors. To increase the probability of success agents consider their cooperation experience. Their research network also represents a map of the successes and failures of their past cooperations and helps agents to search for their best and most promising cooperation possibilities.

Knowledge improvement and acquisition in research projects – Knowledge improves, if it is actively used. Therefore, the expertise level of quadruples, which are used for research, increases. Otherwise, if the knowledge is not actively used, the expertise decreases and finally the respective knowledge might even be lost. During an EU-project agents have the opportunity to learn from their partners. In case of successful results, all actors can acquire the respective kene-elements in dependence of their absorptive capacities.

"Knowledge metrics" – The two most important variables for the measurement of an innovation are the 'probability for success' and 'value of success'. In our model, the two most important indicators to approximate these variables relative to a possible cooperation partner are the 'shortest' and the 'longest'

distance between their kenes. The 'shortest' distance is the distance between the two most related quadruples of the actors and the 'longest' distance is the largest distance between them. The probability of success increases, if the distances are shrinking. However with decreasing distances also the value of success decreases. With these two values, the type of the research and the assumption of risk averse agents we calculate the expected value of the innovation as shown in figure 2.

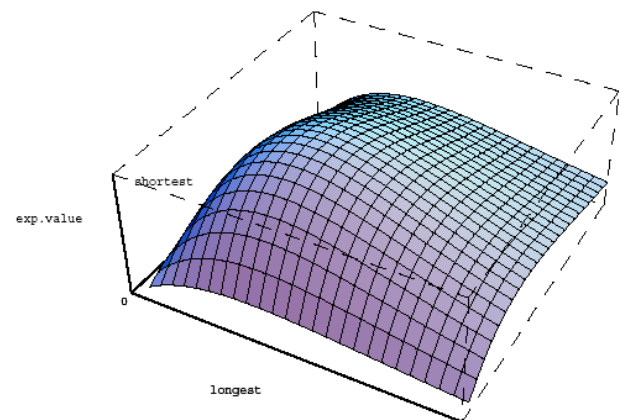


Fig.2: Potential value of knowledge combinations. [Pyka A. and Scholz R. (2008), A narrative Description of the Agent Based NEMO-Model, NEMO WP#3]

First results of the model – So far the prototype model is running and exports several variables e.g. adjacency matrices of the research network, displayed in figure 3.

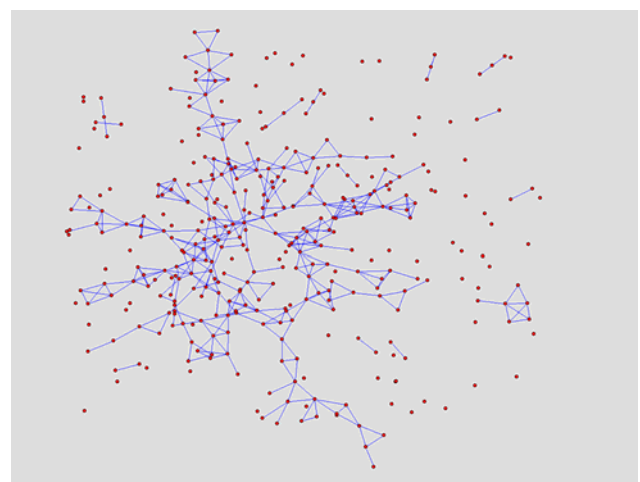


Fig.3: Research network of the NEMO-Model. [Pyka A. and Scholz R. (2008), A narrative Description of the Agent Based NEMO-Model, NEMO WP#3]

RECENT MEETINGS

WP3 WORKSHOP BREMEN, GERMANY (28/29 APRIL 2008)

The NEMO WP 3 meeting took place at the University of Bremen. Andreas Brandes, Karsten Pötschke and Michael Koch of the UCD and Ramon Scholz and Andreas Pyka of the University of Bremen were participating at the meeting.

The purpose of the meeting was to coordinate the work in the WP 3 and to introduce to the recent work done by the participants. During the meeting Andreas Brandes and Karsten Pötschke presented the structure of the "EU-RuleD Archive" - a qualitative database on European Governance Rules stemming from various EU documents concerning the European Framework Programs, explained the functionality of the database and showed the possibilities to search for rules for the agent based model. Ramon Scholz introduced the structure of the SKEIN model. The meeting was used to introduce the group to the concept of ABM, to discuss the coding structure and the possibilities of the implementation empirically derived rules. The topics of the final concluding discussion dealt with the future steps, possible variations and their impacts on the SKEIN model.

COMMENTS AND FEEDBACK

We welcome feedback on our newsletter and work. Do not hesitate to contact us if you have ideas or comments about what you would like to see covered by the newsletter, or if you would like to write a contribution yourself.

For further information about the project visit www.nemo-net.eu or contact the Project Coordinator:

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