

Major achievements of the action E36 “Modelling and Simulation in the Pulp and Paper Industry”

Dr.-Ing. Johannes Kappen

PTS, Hessesstrasse 134, 80797 Munich, johannes.kappen@ptspaper.de

Outcome: Action has been driving the “innovation cycle of modelling and simulation”

The usage of the various key modelling and simulation techniques in pulp and paper is not developed to the same “degree” and one could take the product life cycle as a mould to picture this (Fig. 1): The sales number could be understood as being the usage of the technology concerned. Presuming this it is obvious that the various techniques are located all along the graph in all different phases from introduction to decline. E36 has in this sense for four years been driving the product cycle a little further in performing activities in three different fields: scientific achievements, networking and dissemination / training. The work focus (“Action activities”) of E36 is indicated in Fig. 1.

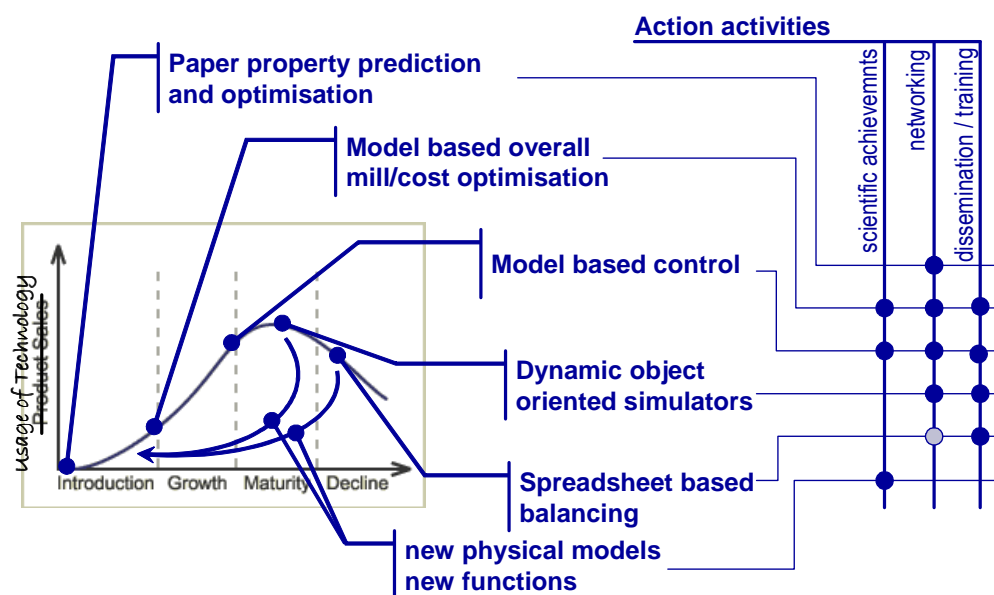


Fig. 1 Activities of E36 within the „life cycle“ of modelling and simulation

Outcome: A series of reports on software use has been elaborated, giving a detailed insight into the use and applicability of modelling and simulation software

Simulation software, being the key technology to be used as a basis has been studied in detail. The work completed covers software for data acquisition, data analysis and simulation. Based on replies given by the participants of the Action and attendees of the various conferences a series on reports on modelling and simulation software has been prepared.

An initial report [i] has been giving an insight to how European experts currently make use of modelling and simulation software. Only 20% use dedicated software to acquire data. Regarding simulation software itself a high share of the answers (41%) indicated an uncertainty or openness towards using another software package. Although today only 24% use software online in mills another 29% plan to do so in future (Fig. 2). The majority (87%) uses software having both steady state and dynamic capabilities.

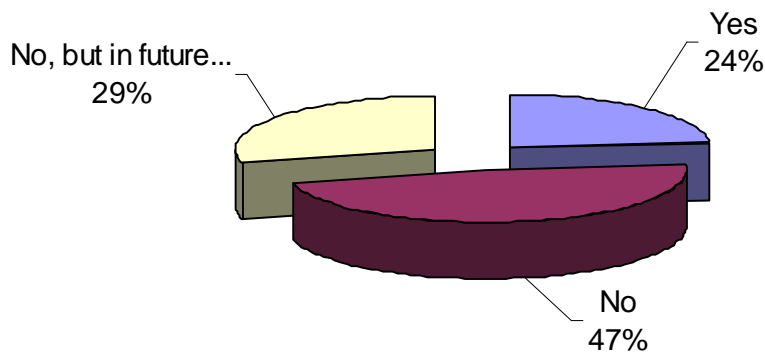


Fig. 2 Answers on simulation software use related to the question “Do you work on-line in a paper mill or pilot plant?”

In a second assessment the users’ requirements for simulation software were investigated in detail [ii]: The total cost of the system, including training and time consumption (when building or running the simulation) has been named to be most important. Related to the supplier, a proper licensing policy is of major importance. Regarding software capabilities the option to handle both chemistry and chemical reactions was ranked high as well as compatibility with other software packages. In a third report [iii] the main specification for software packages available was reported. This report was completed with the support of the respective suppliers. A further survey on software performance assessment will be published in the course of the Action.

Outcome: Rebuilt of sample model in different software environments with a special emphasis on the involvement of young scientists

Sample models have been set up and rebuilt in various software packages. These sample models cover a cleaner model, a washer model and a dynamic model of the constant section of the paper machine (Fig. 3). These exercises provided a practical basis for a direct exchange of knowledge and expertise. Most of the models have been built by young scientists thus providing opportunities for education and training.

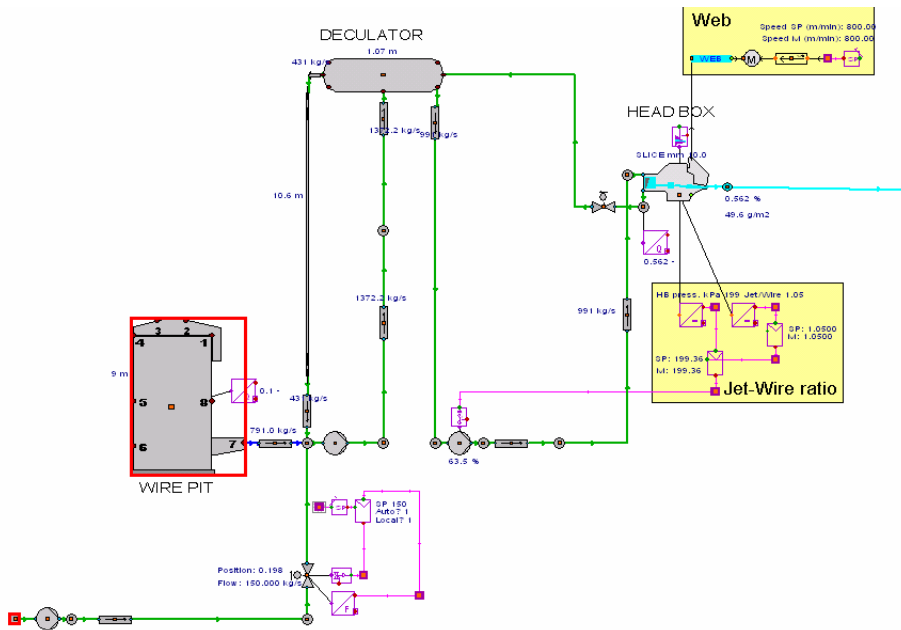


Fig. 3 Example model 3 “headbox control problem”

Outcome: Action defined future research needs

In depth discussion on future research needs to take place within the Action. A short summary of these talks is given below.

An important focus of future research is to better perform process based product optimisation in order to predict and control paper properties based on process variables.

Activities have to lead to a more reliable and precise paper property prediction. The task is to calculate paper properties based on the properties of all relevant components (pulp, fillers, chemical additives etc.) and the boundary conditions present during sheet forming, pressing and drying. Finally this should lead to master both process performance and product properties. As one important precondition, it is needed to interweave the first to two threads into a common web of knowledge. In addition random effects, margin errors and process limitations have to be more clearly understood. Another challenge will be to master the complex pulp and paper value chain. By integrating process models with cost models it will be possible to unveil currently hidden factors that impact the economic balance of the individual mill. Thus it will be possible to calculate on the socio- and macroeconomic level the effect, all various sub processes have on the paper chain performance.

Outcome: Elaboration of research ideas as nuclei for future research collaboration

Within the frame of the Action at several meetings various research ideas were collected to provide a focal point for future collaboration. These ideas are listed in the following table (table 1).

Tab 1: Research ideas generated

Idea #	Description
1	Designing a handheld device to support the operator to take optimum decisions
2	More robust models – a move from statistical to physical models
3	Decision support for higher energy efficiency
4	Safeguarding the validity of advanced process control models over the full life cycle
5	A fingerprint approach on the process state as key to process stability and reproducibility
6	Holistic modelling approach to optimise the pulp and paper value chain
7	Concurrent design of material and information flows
8	Fault tolerant control for complex systems
9	Energy S.O.S - Performance monitoring for maximising production efficiency while maintaining product quality on unit operation level
10	TOMOPAP - Breakthrough in paper property simulation based on tomographical information to minimize production cost

Outcome: Impact of the Action of NRA

The topic has been introduced into the national research agendas of several European countries, thus providing further options for research funding.

Outcome: Benefits provided to the industry

As an effect of the Action an increased attention to modelling and simulation can be observed in the European pulp and paper industry. Some of the major paper companies initiated targeted activities. Suppliers present in the Action have focussed their service offers on modelling and simulation and/or developed new simulation and model-based optimisation tools.

Outcome: Scientific collaboration initiated in Europe

Finally, scientific networks have been initiated and installed that originated from short-term scientific missions performed within the frame of the Action.

One example is the collaboration between a German and a Finnish partner. Within the frame of several STSM missions performed German young researchers helped to upgrade pilot PM in Finland and at thereafter had the possibility to perform trials that they could not perform at their research site in Germany. Models were built based on the results in order to ultimately optimise synchronously formation as well as retention.

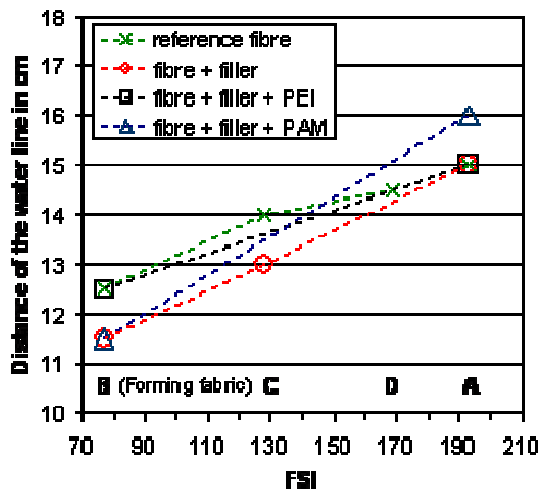


Fig. 4 Results achieved at the pilot paper machine in Finland [iv]

Ourcome: Collaboration with canadian reserachers

Special attention has been given the international collaboration. Close and fruitful contacts with Canadian researches, namely Prof. Jean Paris of École Polytechnique de Montréal and Prof. Guy Dumont of the University of British Columbia have been established. The Action thus has received mayor inputs within conferences and workshops.

Outcome: Publications, Workshops and conferences

E36 has initiated, organized and supported various conferences in the area of modelling and simulation. In addition various publications have been produced and are publicly available to date. Scientific achievements have been compiled in a dedicated book [v]. Knowledge on simulation software and its use has been collected, documented and made available to the general public on www.coste36.org.

Literature

- [i] Alonso A., Negro C. and A. Blanco; Current use of software in COST Action E36 - Report from surveys done at COST Action E36, 2004
- [ii] Alonso A., Negro C. and A. Blanco Users' Requirements for Simulation Software 2005; <http://www.coste36.org/publications.htm>
- [iii] Alonso A. and C. Negro, Main specifications of different software packages (June 2006); <http://www.coste36.org/publications.htm>
- [iv] Christian Mannert, Jani Lehmonen, Evaluation trials on pilot paper machines to determine the effect of different forming fabrics on drainage, retention and formation (in preparation)
- [v] Erik Dahlquist ed., Use of modeling and simulation in pulp and paper industry, Mälardalen University Press, 2008; 331 p.

Munich, July 2009