Expert System of UGS – an Efficient Tool for On-line Performance Management and Optimization

Vladimír Onderka, Miroslav Dressler, RWE Transgas Net, s.r.o., Brno

Otto Severýn, Technical University, Liberec

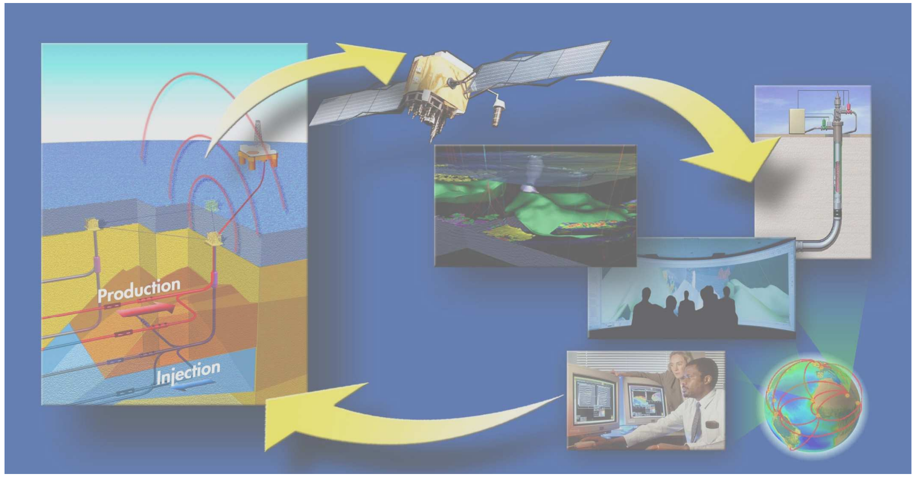
Matteo Giovannoli, Georg Zangl, Schlumberger, Baden

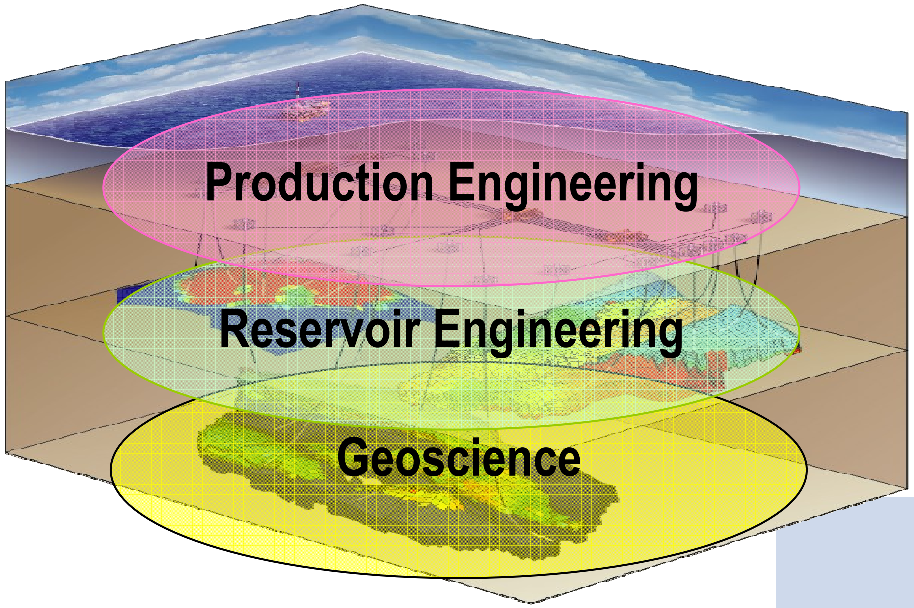
Expert System of UGS – an Efficient Tool for On-line Performance Management and Optimization

- PC system based on artificial intelligence for data mining and numerical/analytical simulators used for on-line optimization and predictions.
- Day-to-day optimization and short/long term planning with on-line connection to dynamic data – SCADA, numerical forecast of UGS performance with respect to conditions on the market specified by dispatching center and finacial management.
- Optimization of UGS and enhanced control of gas production/injection with respect to reservoir and well properties, conditions of surface technologies and distribution pipelines leads to realization of full storage potential and reducing operational costs and future investments.
- ES started by RWE-Transgas with Schlumberger and ESK in 2004.

Smart UGS Concept

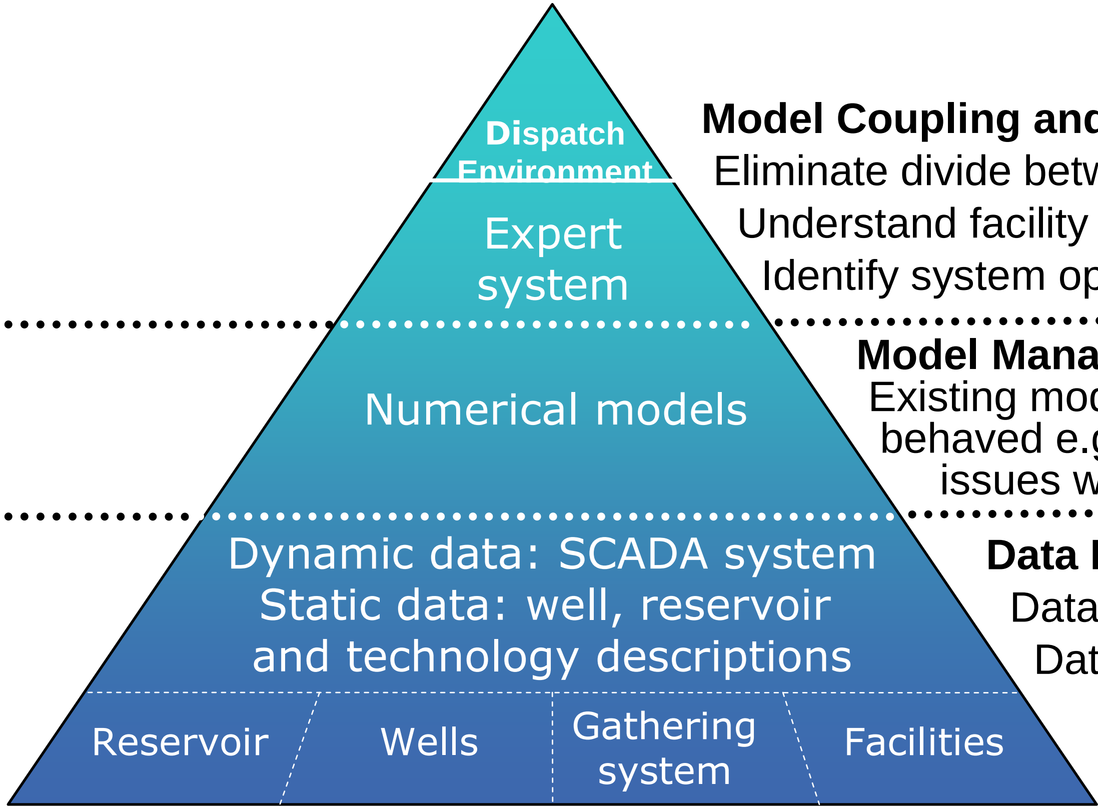
- An instrumented and controlled underground gas storage that utilizes Information Technology to bring together people, technology, processes and information in a dynamic, secure and global system to reduce risk, lower cost and enhance rates and active capacities. Expert system is intended for day-to – day optimization of UGS operation.





Integration Platform

RWE Transgas Net



Level 3

Model Coupling and Automated Execution

Eliminate divide between up- and downstream

Understand facility constraints on reservoir

Identify system optimization opportunities

Level 2

Model Management

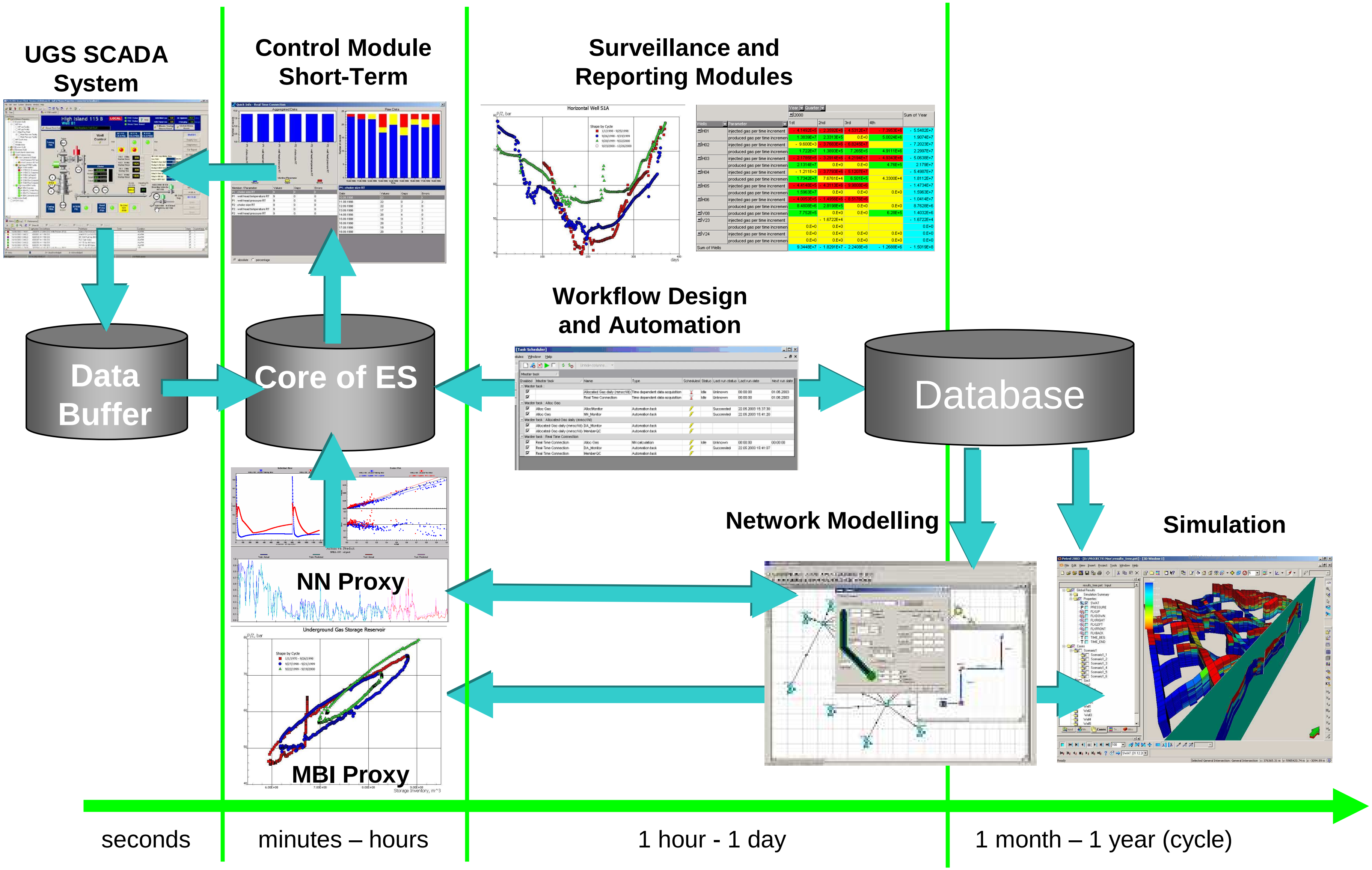
Existing models: ensure that they are well-behaved e.g. no significant convergence issues when run stand-alone

Level 1

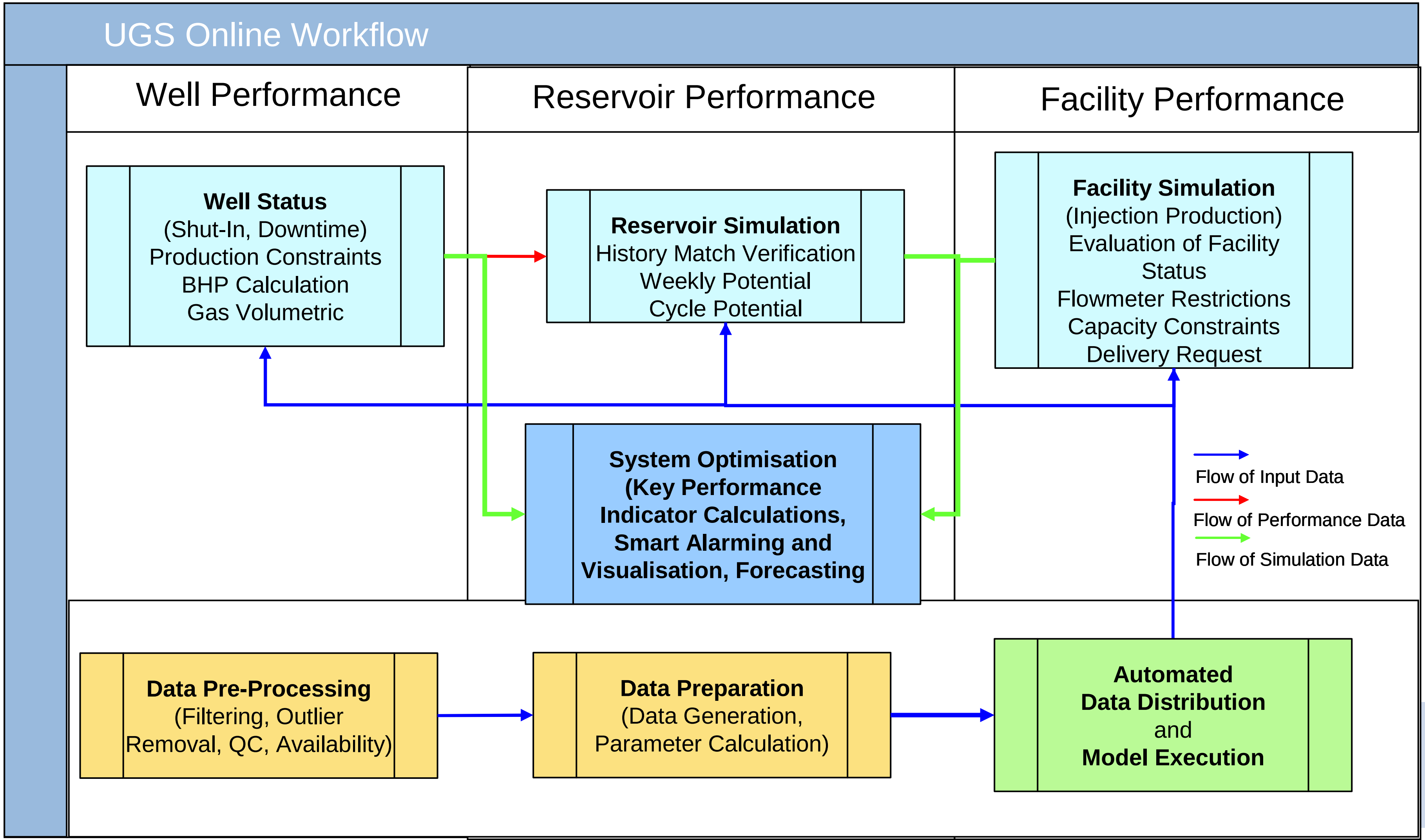
Data Preparation and Pre-Processing

Data QC, Parameter Calculation, Data Distribution, Event Detection

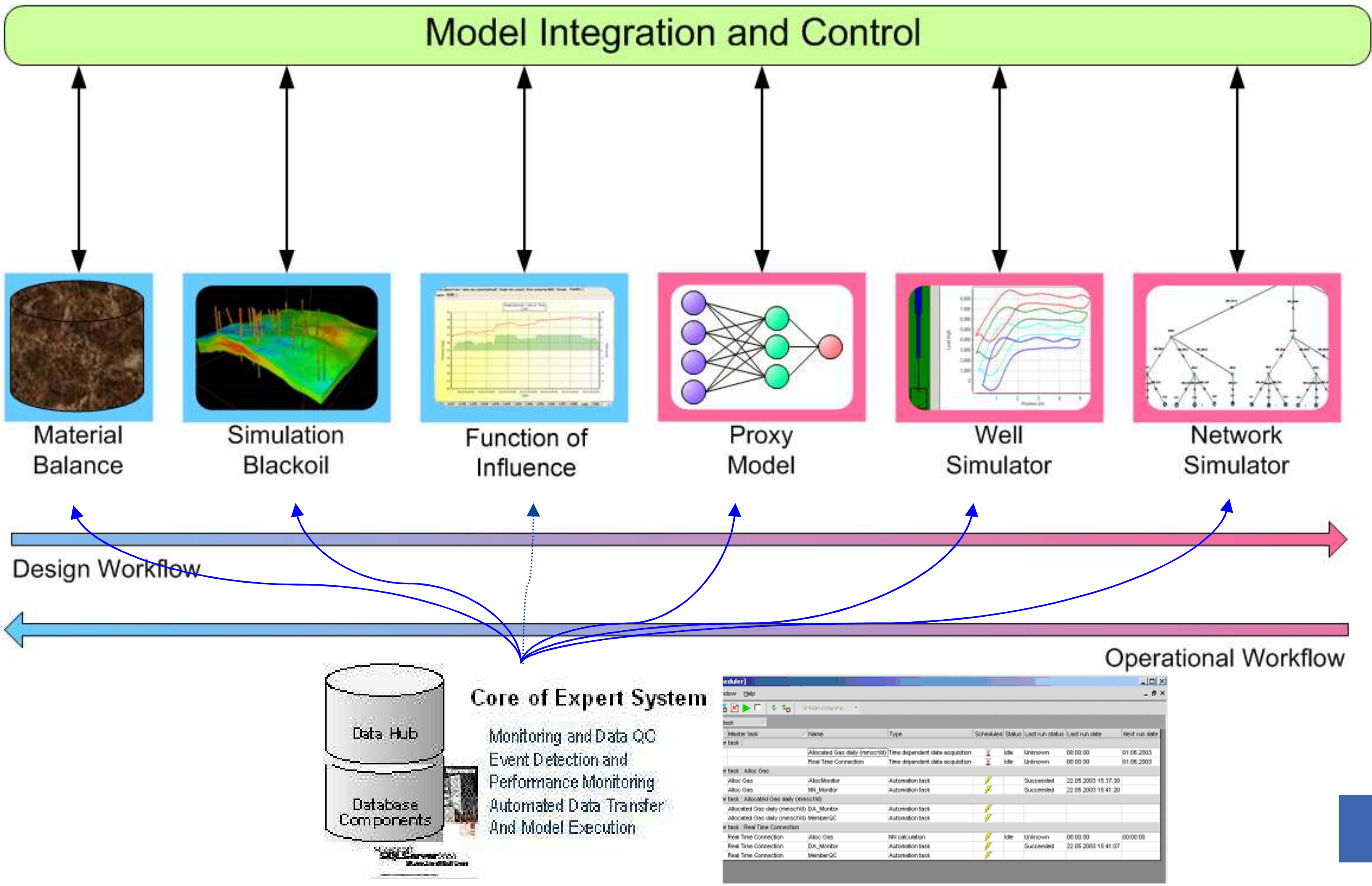
ES UGS – basic chart



ES UGS-Workflow

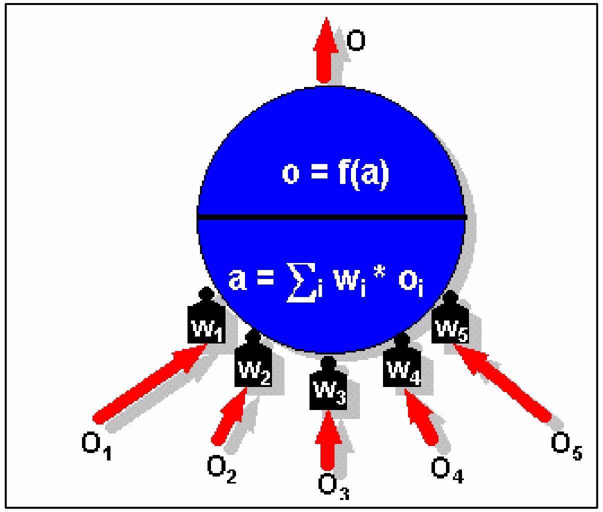


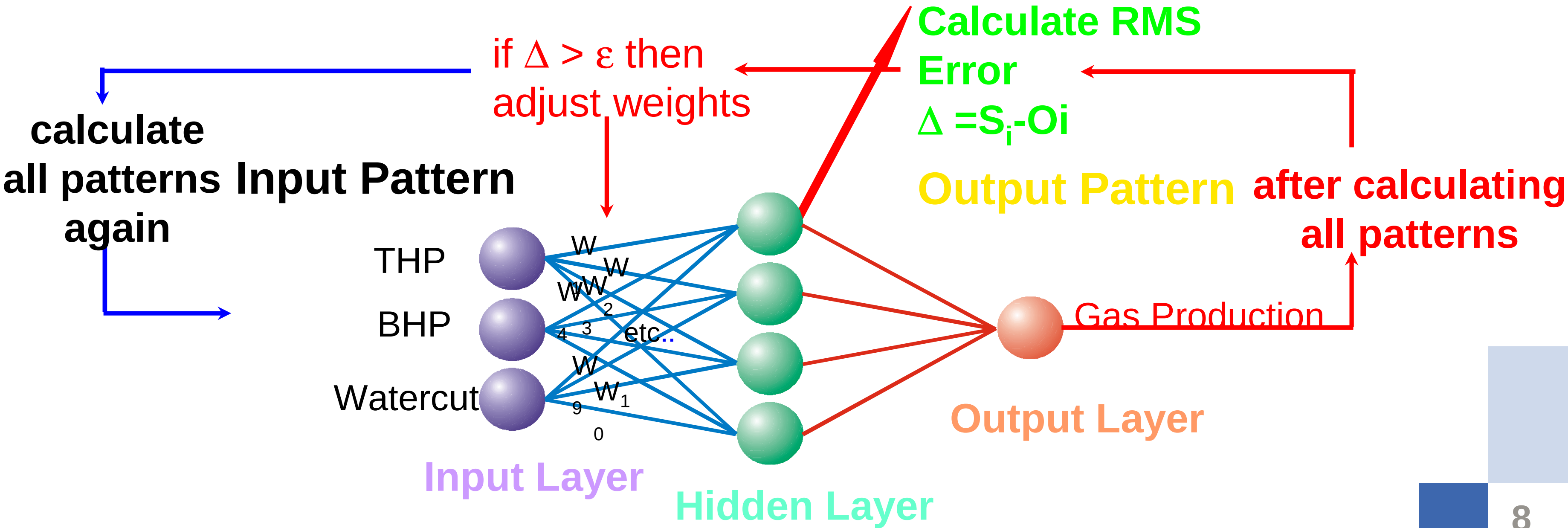
Model Control Processes



Neural Networks
Training & Architecture

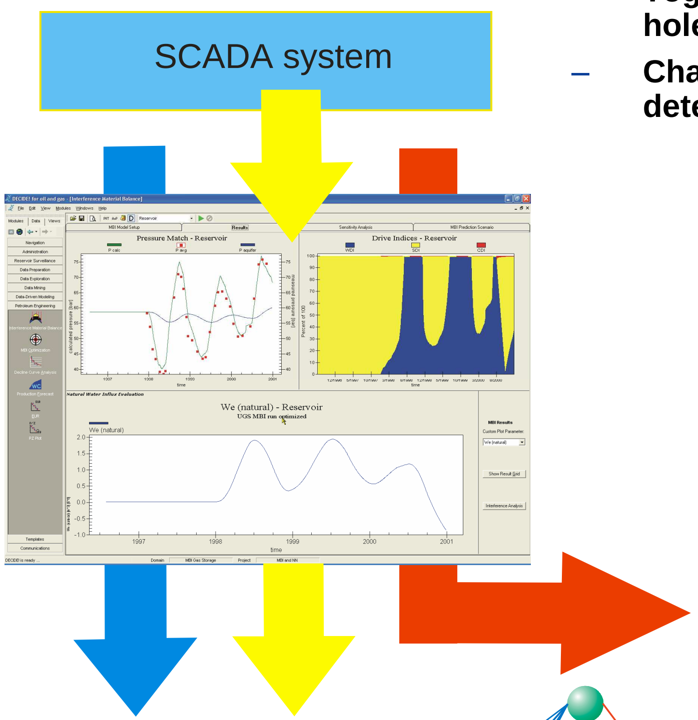
- Neural Networks “learn” during iterations
- Continuous iteration through all training data
- Weights are adjusted to minimize error (RMS)

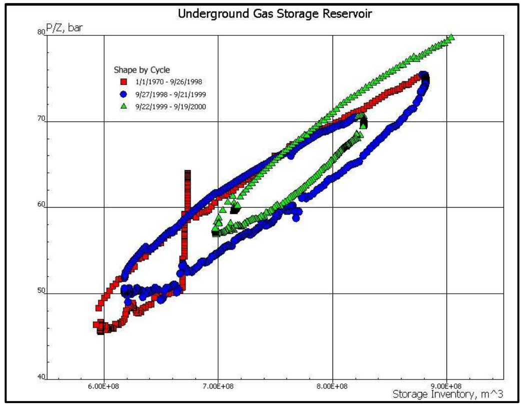




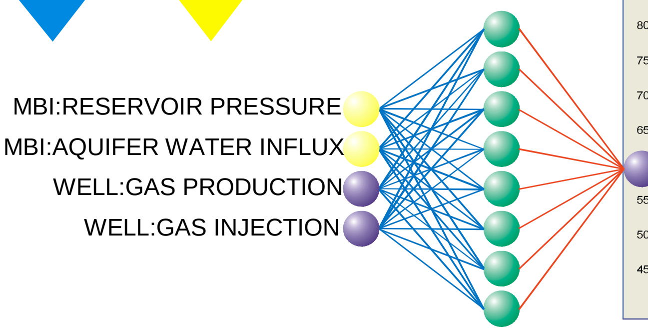
Reservoir/Well Performance Surveillance

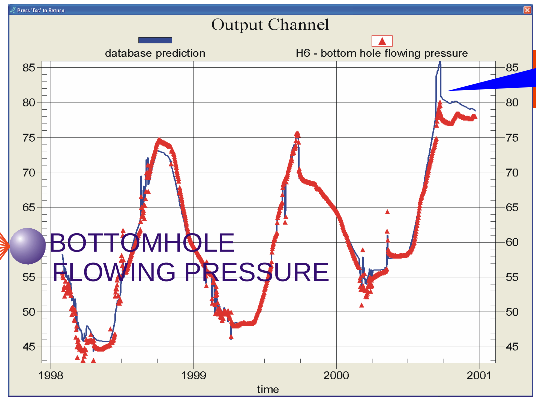
- Real-time surveillance data is forwarded to the dynamic model to update the pressure and water influx prediction.
- Together with updated rate data, the Neural Network calculates a bottom hole flowing pressure which is then compared with the actual measurement.
- Changes in the well's PI due to increased sand production could be determined very early.





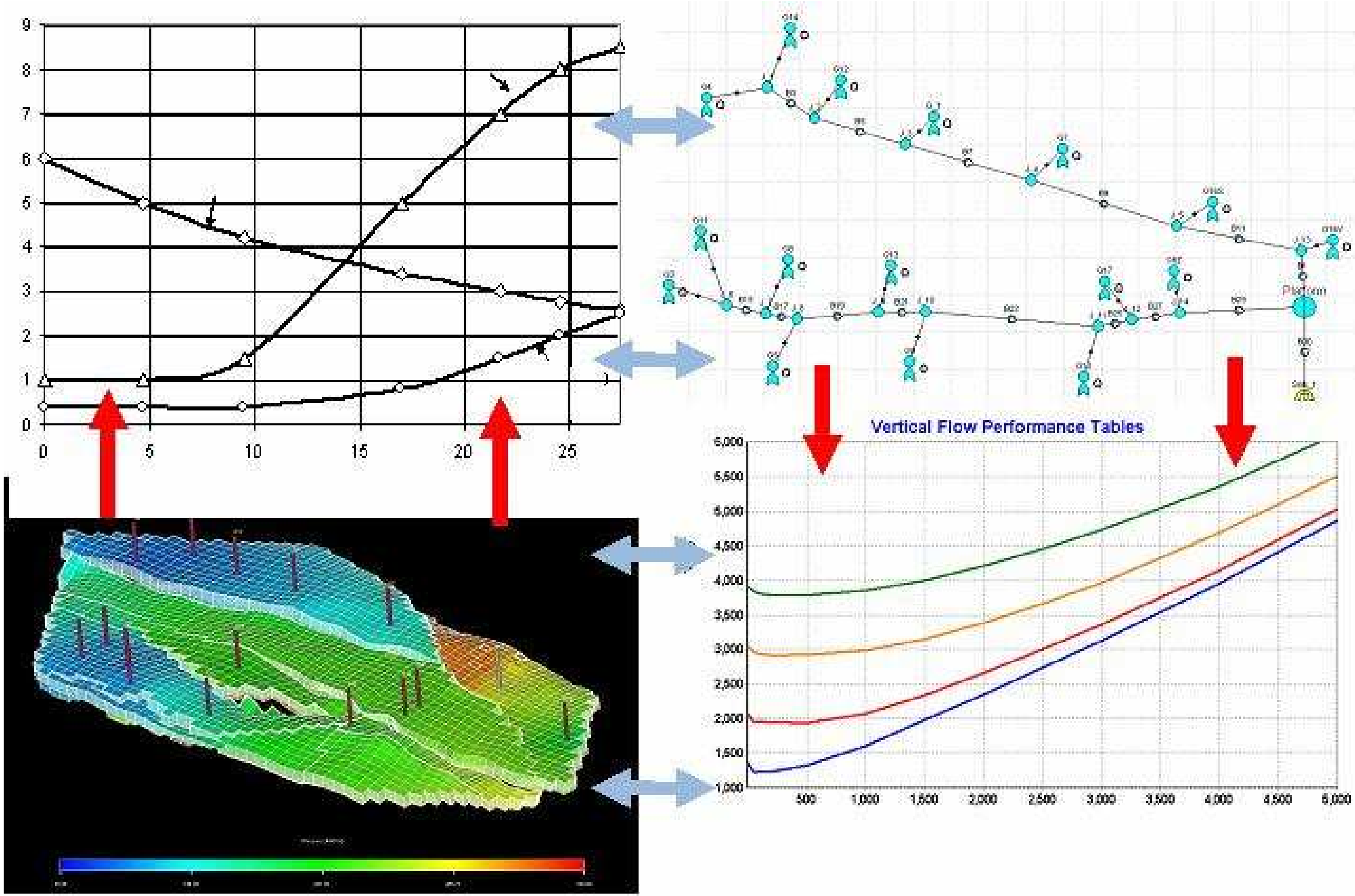
- Investigate the performance of your gas storage reservoir
- use colours to identify your time cycles (e.g. yearly)
- use online data queries
- identify trends
- identify storage volumes



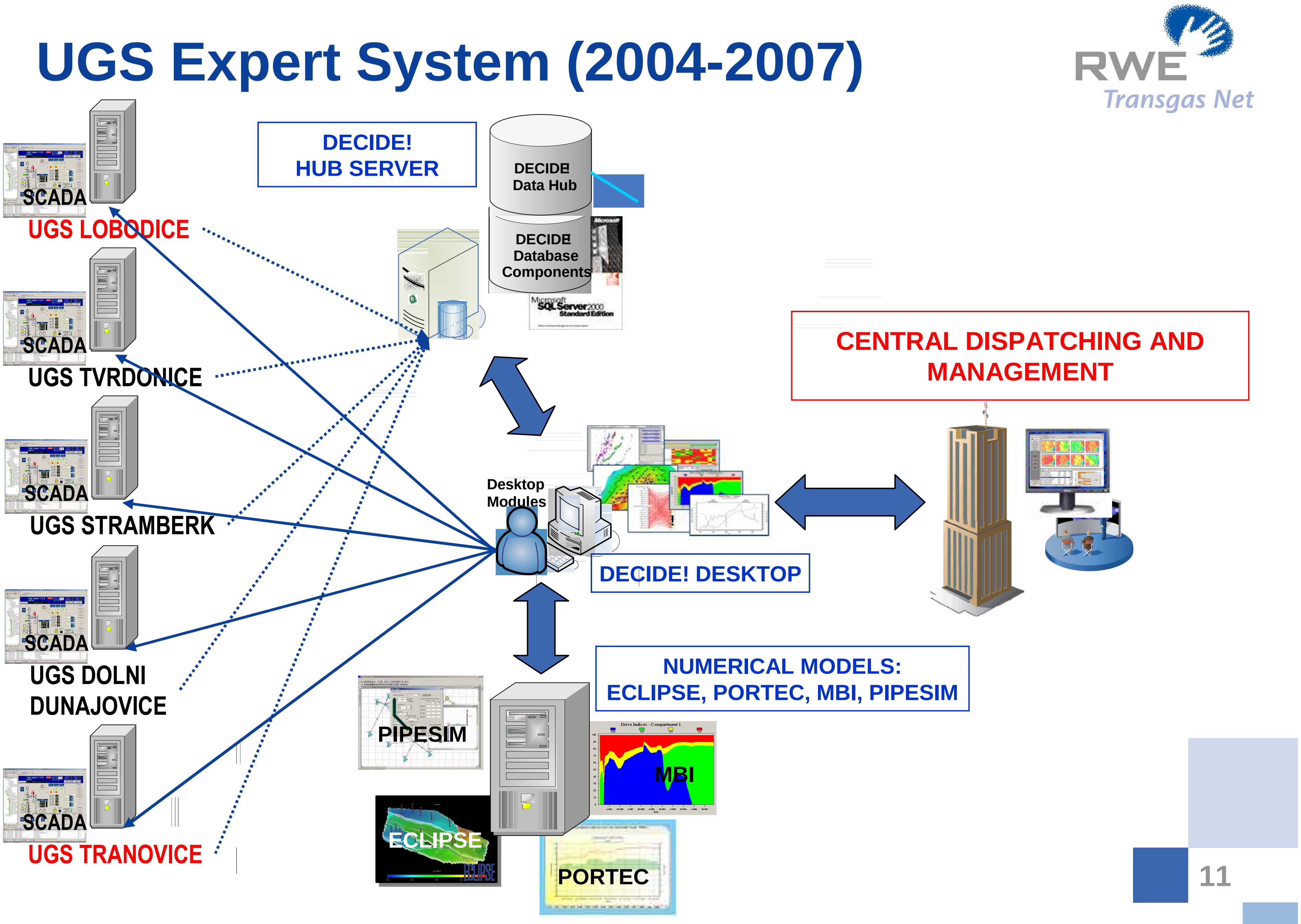


ALARM! Measured bottomhole flowing pressure deviates from expected pressure behavior! Well PI changed!

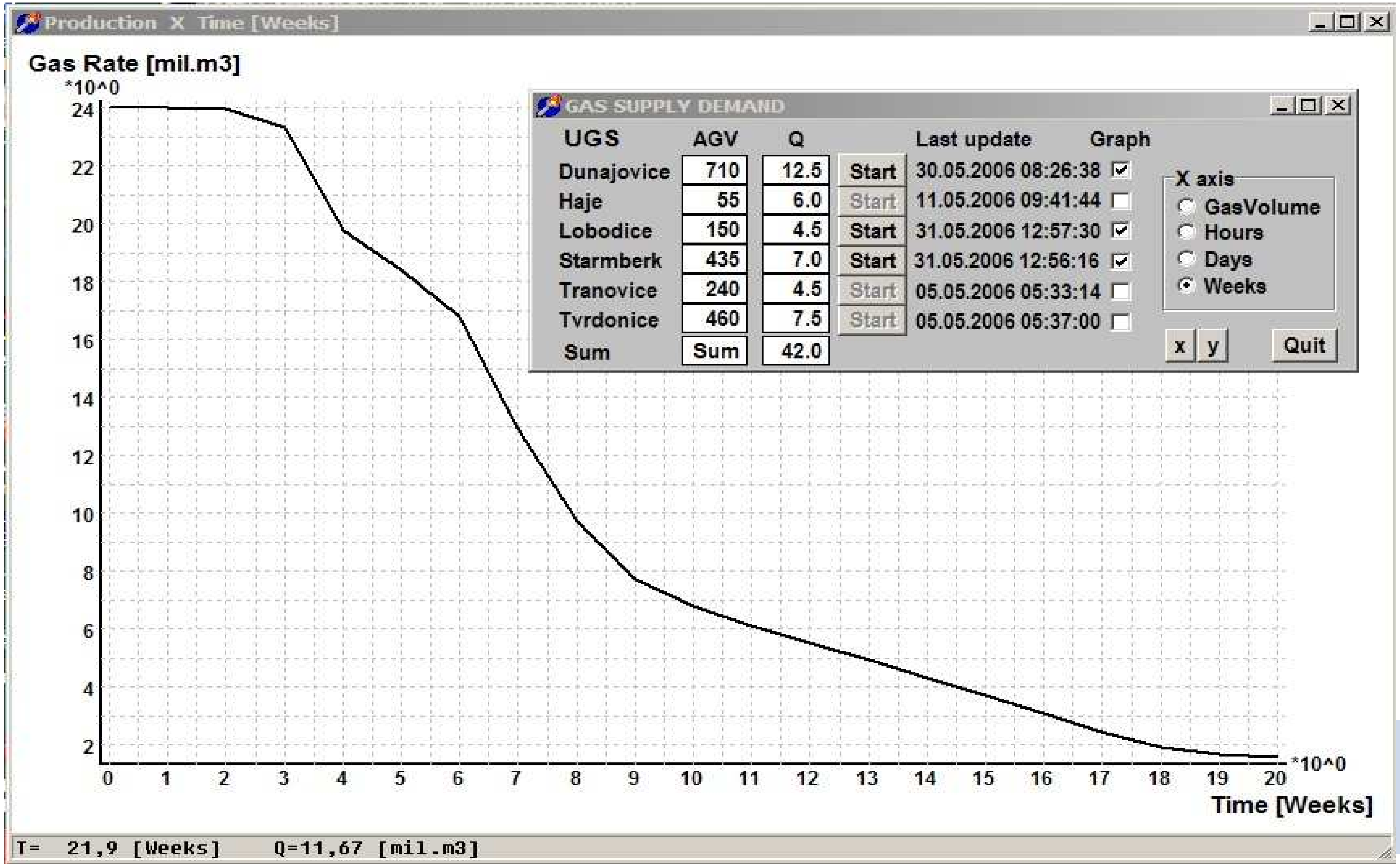
Surface – Reservoir Coupling Optimisation and Prediction



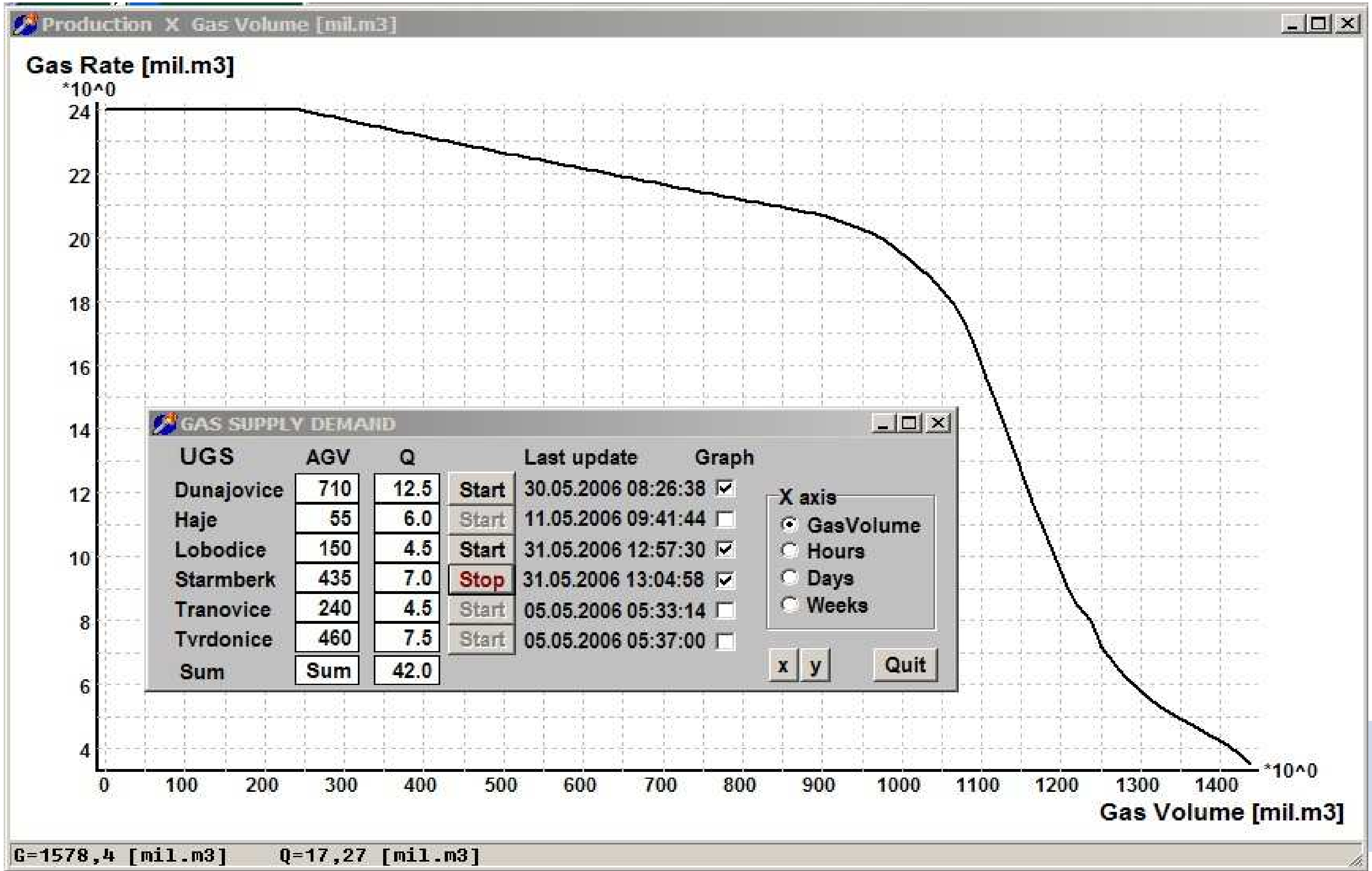
UGS Expert System (2004-2007)



Dispatchers environment and operational tool – automated update and forecast



Dispatchers environment and operational tool – automated update and forecast



Conclusions:

RWE Transgas Net

- The challenge of ES development lies in direct remote analyses and objective unbiased operation.
- Cost savings are related to a high level of automation and continuous optimization of reservoir and surface network management of UGS operation
- By the end of 2007- ES application on all UGS facilities of RWE-Transgas, a.s.