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Modeling Basics

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Outline

- Definitions and terminology
- Types of models
- What is modeling?
- Why do we model?
- Industry-standard modeling protocol
- Design versus process models

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Definitions

- System

*Part of reality that is separated from its environment
on the basis of a purpose defined by the researcher*

- Model

*An approximate description of a part of reality
considering only those aspects that are of interest*

- Simulator (= Virtual experimenter)

*Tool that allows efficient manipulation of a model
to gain insight in the “behavior” of the real system*

Definitions

- Steady state simulation

Variables are independent of time

because time is not considered in the model (**steady state model**)

OR the input to the **dynamic model** is constant (influent AND operation)

- Dynamic simulation

Variables are function of time

because time is considered in the model (**dynamic model**)

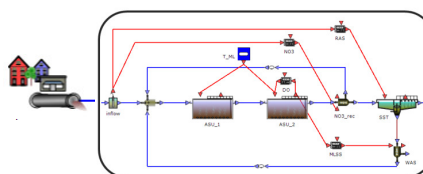
AND the input to the **dynamic model** is varying (influent OR operation)

Models take many forms

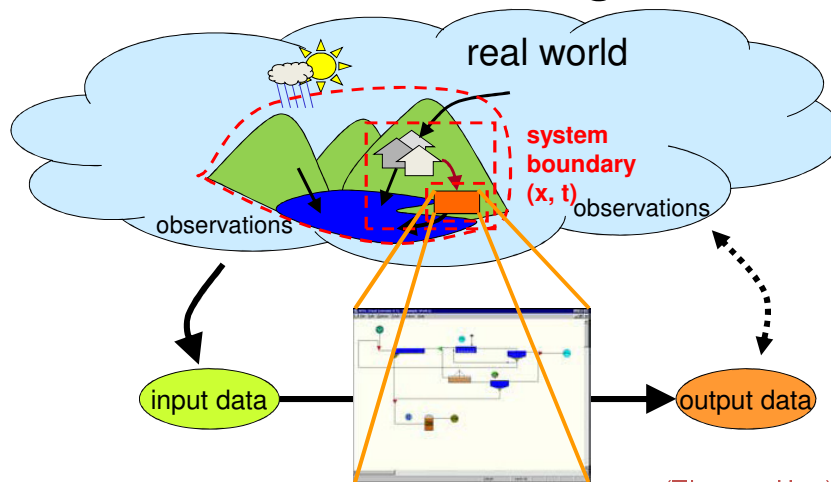
- Mental models (ideas, concepts, ...)
- Verbal models ("description in words")
- Scale models ("house in cardboard")
- Mathematical models ("equations")

- Different sets of equations, leading to:

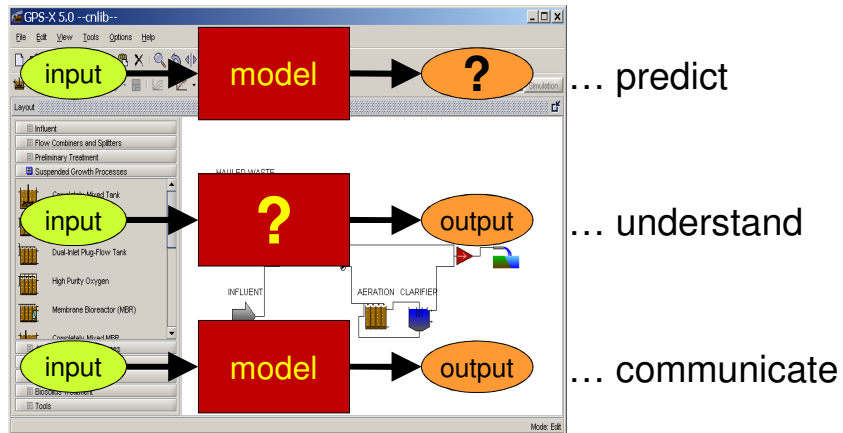
- ✓ Design models
- ✓ Process models
- ✓ Cost models
- ✓ Influent models
- ✓ Controller models



What is modeling?



Why modeling?

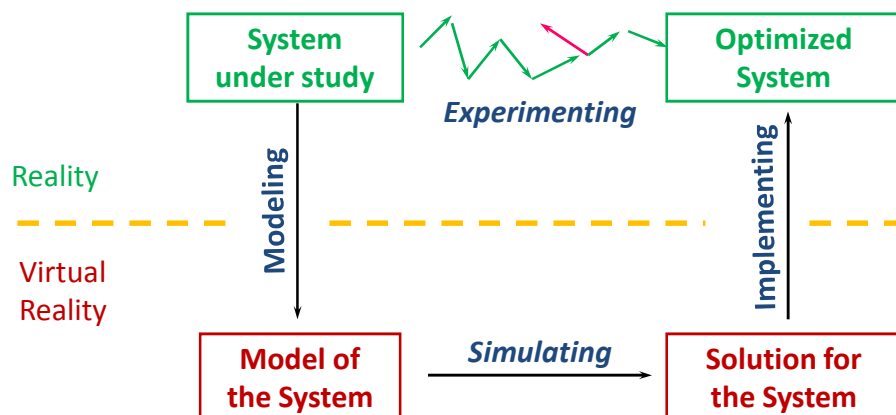


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Why modeling ?

Solving Problems for complex systems



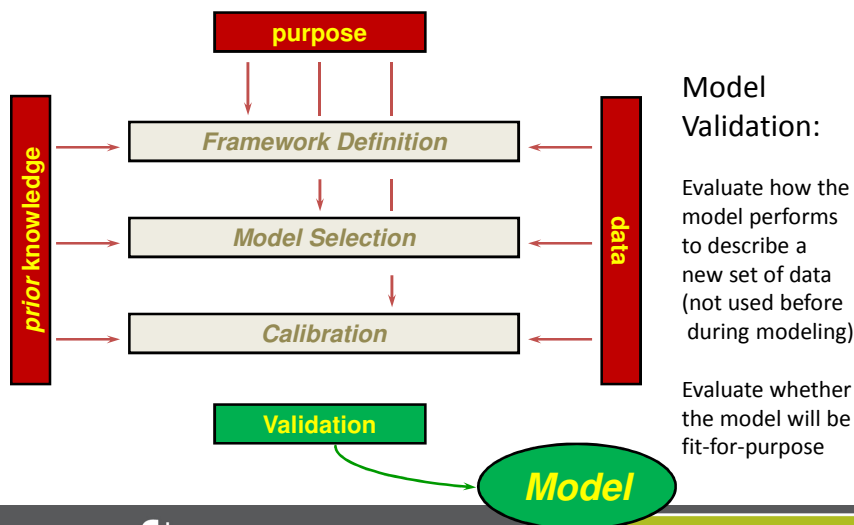
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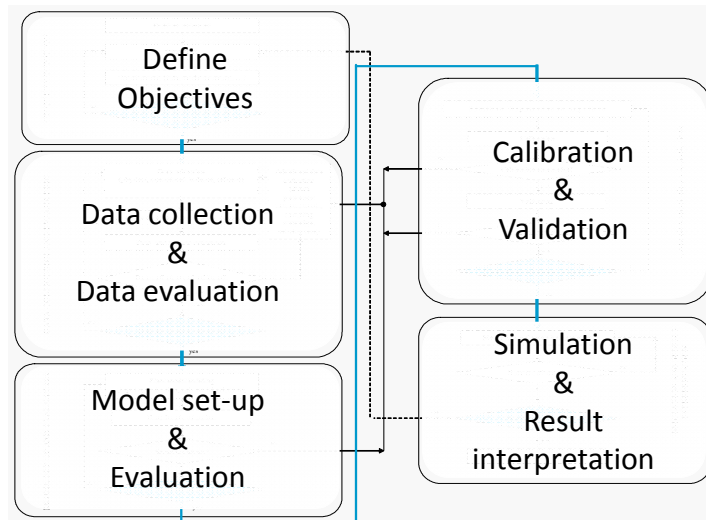
Model building: Starting points

- Purpose of the model
 - Increasing understanding *(Think tank)*
 - Summary of knowledge/data *(Communication)*
 - Prediction of future behavior *(Control)*
- *Prior knowledge*
 - Experience
 - Existing models
 - Literature (facts, phenomena, theories, ...)
- Data
 - Existing data
 - New data collected in view of model building

The model building exercise

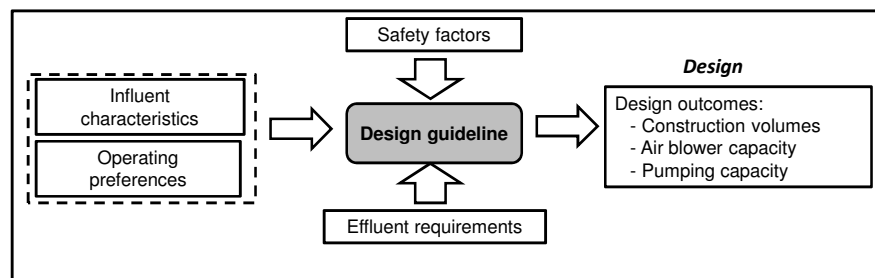


Modeling protocol



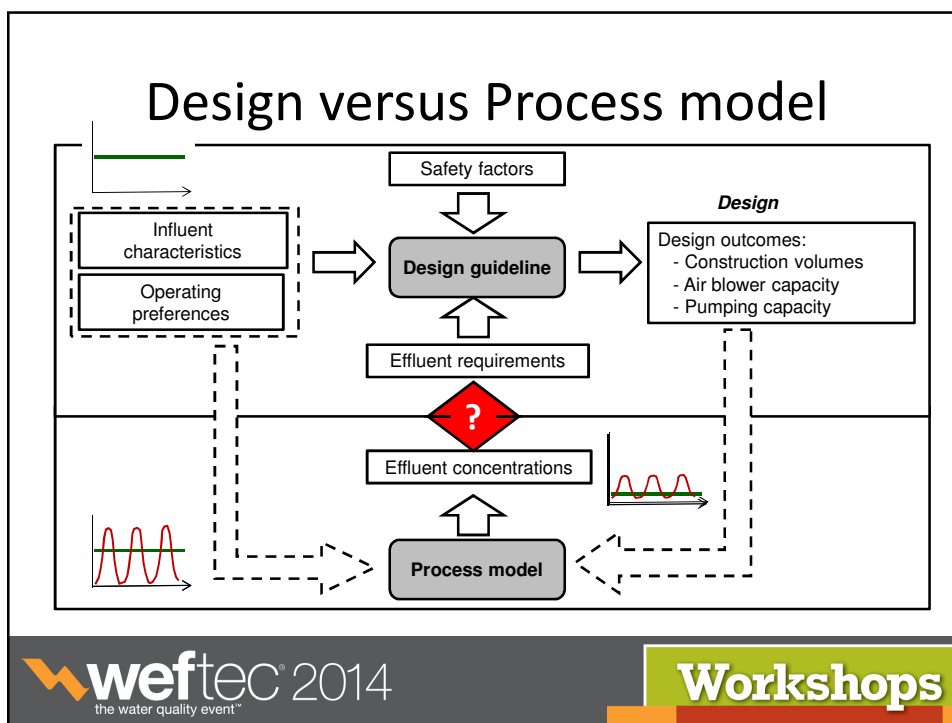
Design versus Process model

- Typical use of spreadsheet design model



$$P_{X, PSS} = \frac{YQ(S_o - S)}{1 + k_d \Theta_c} + \frac{f_d k_d YQ(S_o - S)\Theta_c}{1 + k_d \Theta_c} + Q(nbVSS) + \dots$$

$$R_o = Q(S_o - S) - 1.42 P_{X, bio} + 4.33 Q(NO_x)$$

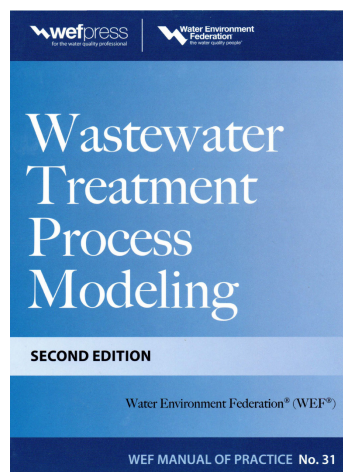


Conclusions

- Models are:
 - multi-purpose
 - a summary of current knowledge
 - cost-effective tools for solving problems
 - easy to use thanks to protocols that have a proven record
 - included in industry-standard software

This workshop

- Based on MOP31:



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