

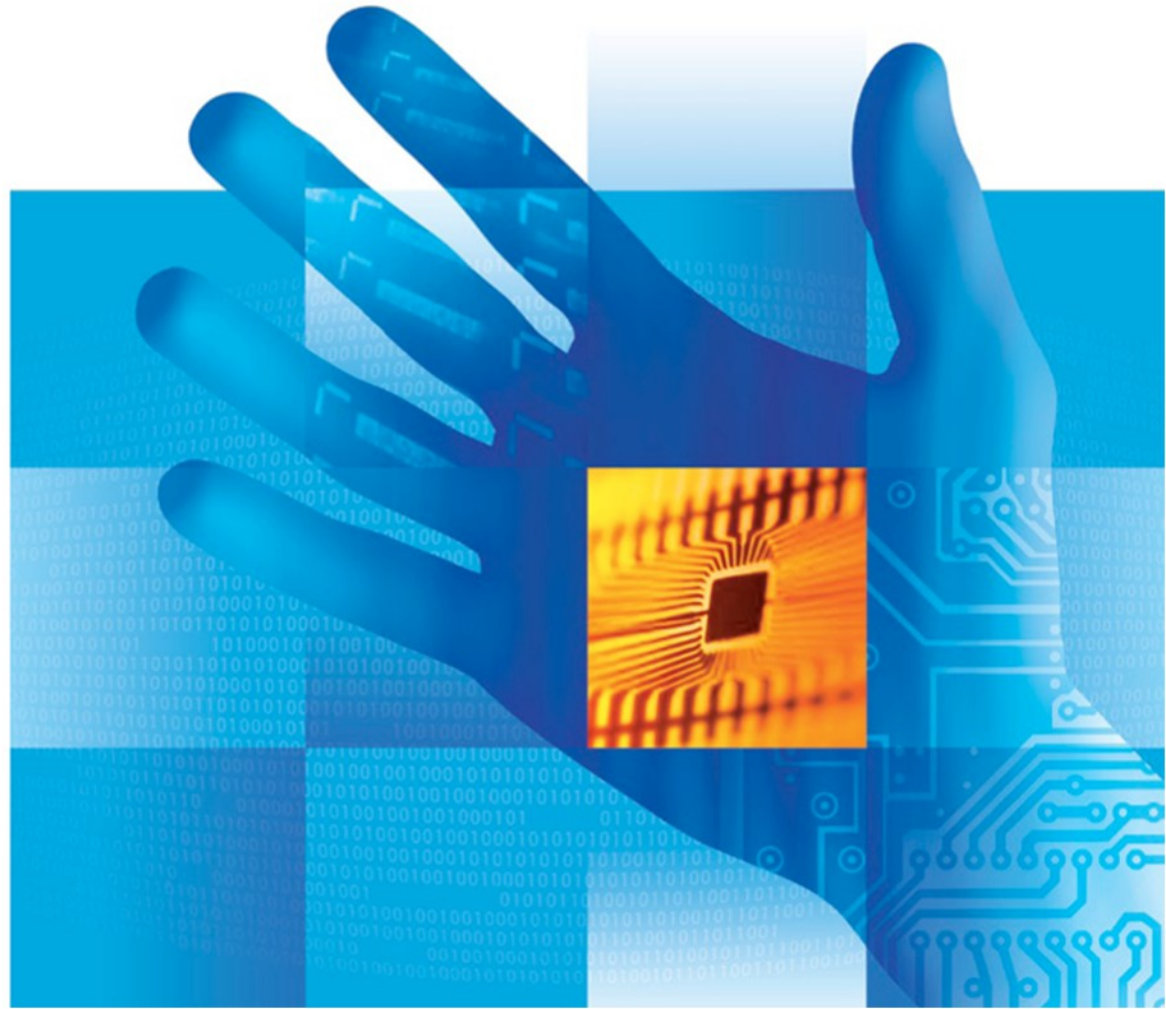


# Simulation of the Flood Warning Process with Competency-based Description of Human Resources

**Štěpán Kuchař**  
Michal Podhorányi  
Jan Martinovič  
Ivo Vondrák

[stepan.kuchar@vsb.cz](mailto:stepan.kuchar@vsb.cz)

VSB-TU Ostrava, IT4Innovations  
Czech Republic



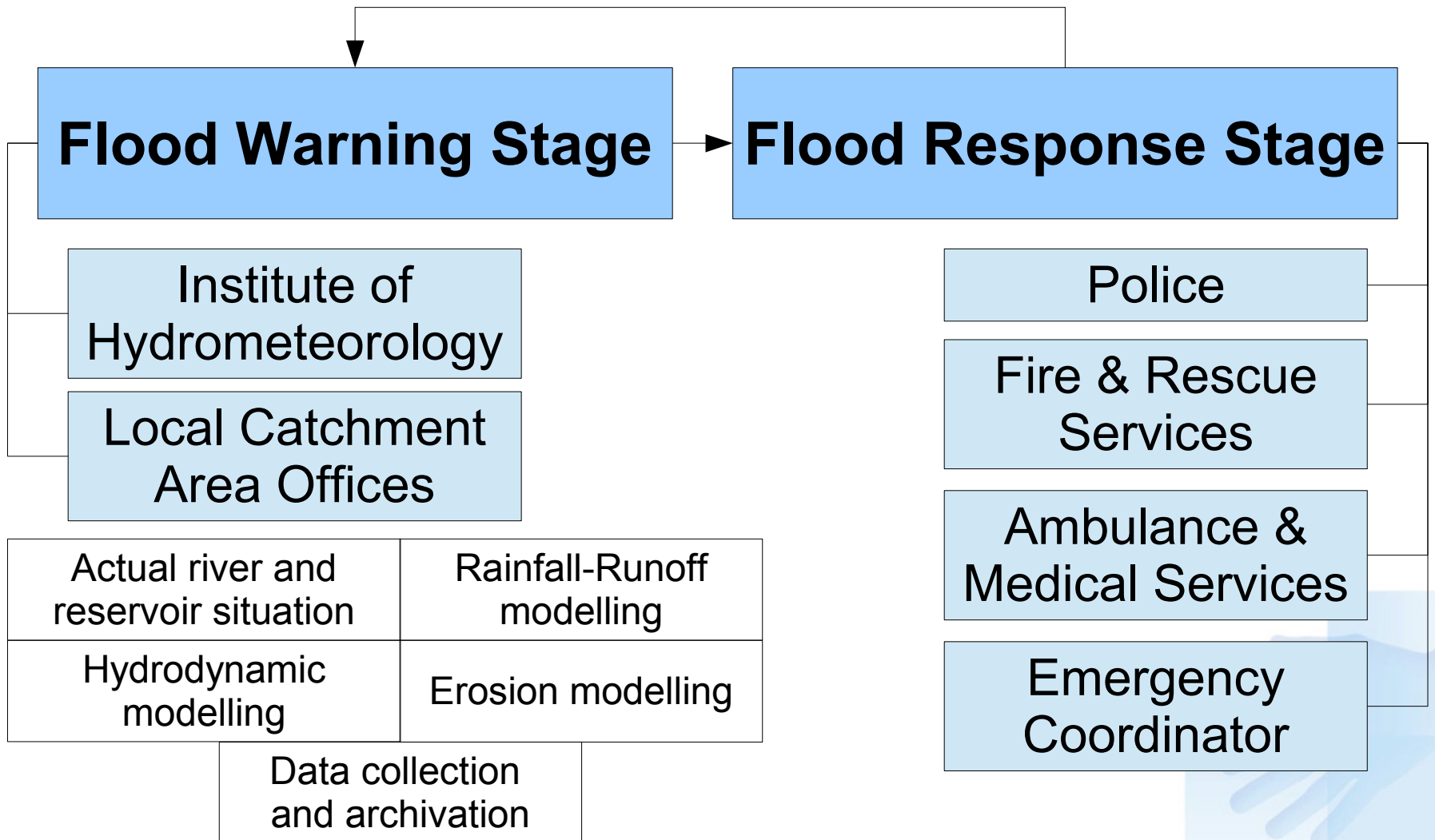
# Flood Prediction Motivation



- Floods represent major problem in many regions around the world
- Czech Republic has been hit by a growing number of floods over past years
- It is important to specify and optimize the flood warning process to minimize the flood impact
- Simulations can help identify bottlenecks in the process caused by wrong workflow structure and also by wrong allocation of human resources



# Flood Warning Process



# The BPM Method



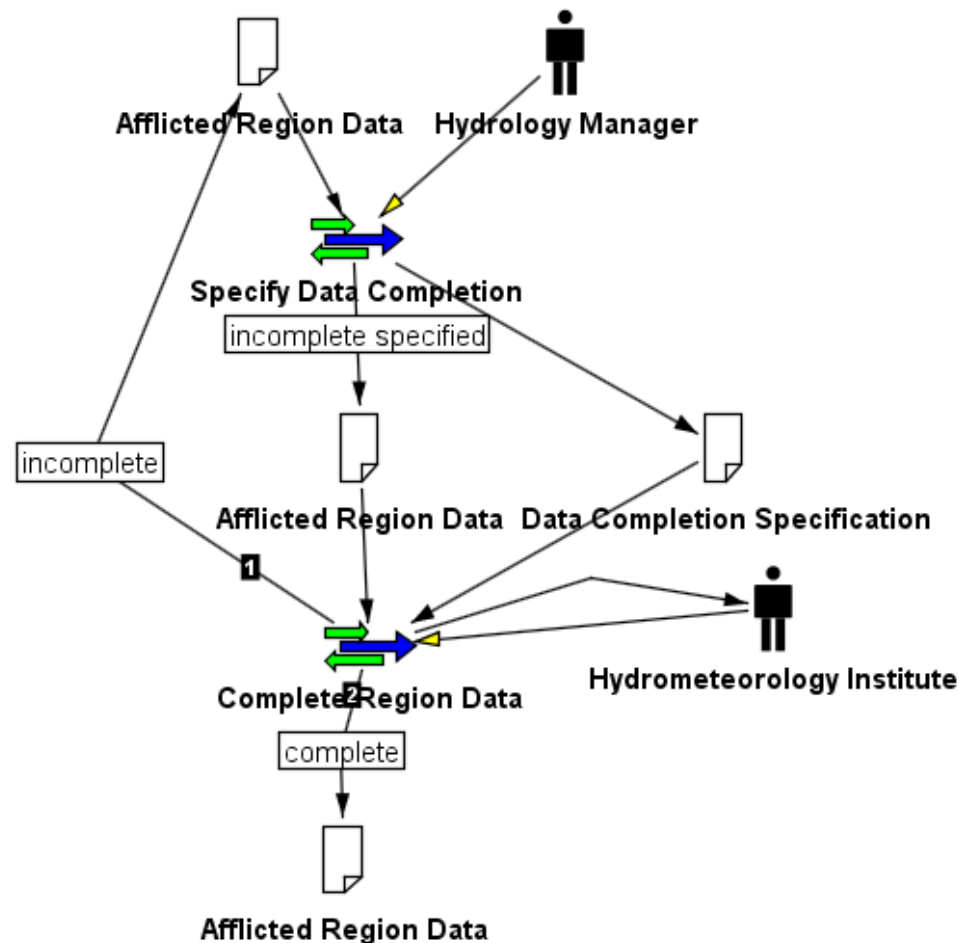
- Modelling and simulation method for business processes
- Provides discrete event simulation environment with stochastic properties and generic resource sharing
- Defines three basic process models:
  - Architecture of the process
  - Objects and resources utilized in the process
  - Behaviour of the process – most important for simulations



# Coordination Diagram



- Visual representation of the behaviour model



# Human Resource Competencies



- Description of human resources is provided by
  - **Competency models**
  - **Skills frameworks**
- **Competencies** are defined as sets of knowledge, abilities, skills and behavior that contribute to successful job performance and the achievement of organizational results.
- **Skills frameworks** describe specific skills for one domain rather than general competencies



# Competency Models



- Describe “How to measure and evaluate” individual competencies
- Measured by a number of advancing stages
- Higher levels of competency include all lower levels
- First historical competency model was specified by five levels
- There is no standard for how many levels should a competency model have



# Competency Levels Example



- A few competencies that one of the Hydrology Specialists in the flood warning process could have (on a 5-level scale):

Competency	Level
Catchment area of the Odra river	4 <sup>th</sup> level
Catchment area of the Opava river	1 <sup>st</sup> level
Rainfall-runoff modelling	2 <sup>nd</sup> level
Hydrology analysis	3 <sup>rd</sup> level
Communication	2 <sup>nd</sup> level



# Competency-based Activity Requirements



- Describe what competencies should the human resource performing this activity know
- Simple requirements for the activity of analysing results of hydrology models

Competency	Level
Catchment area	3 <sup>rd</sup> level
Hydrology analysis	3 <sup>rd</sup> level
Cartography	2 <sup>nd</sup> to 3 <sup>rd</sup> level
Statistics	2 <sup>nd</sup> to 4 <sup>th</sup> level



# Competency Description Integration

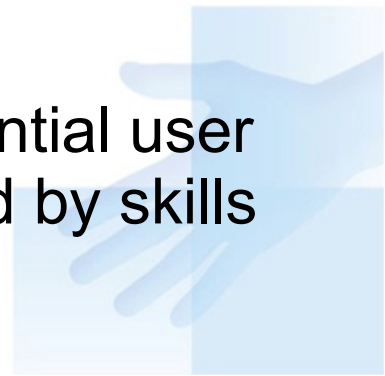


- BPM Method is an object-oriented method
- Competency-based description was introduced into the method by expanding object definitions of simulated objects
- Resource competency extension
  - Set of competencies and their levels for each resource
- Competency parameters extension
  - Each process instance defines multiple parameter sets and process case priorities with different probabilities
  - e.g. 20% Opava catchment, 80% Odra catchment

# Competency Description Integration



- Activity requirements extension
  - Set of required competencies and their requirement limits for each shared input resource of each activity
  - Importance of each competency requirement
- Competency-based resource evaluation
  - Activity with requirements needs to start => suitable resources are evaluated from all available resources
  - Competencies are encoded to vectors and evaluated in the vector space model
  - Resources with better results than the referential user are suitable to perform the activity and sorted by skills



# Resource Utilization and Unavailability



- **Utilization** – total time when resource is performing any activity
  - not very useful for optimizing resources
- **Waiting time** – time when resource is performing an activity and another activity needs the resource
  - very useful in optimizing resources – minimalization of waiting times by adding more resources – raises the process cost



# Case Study



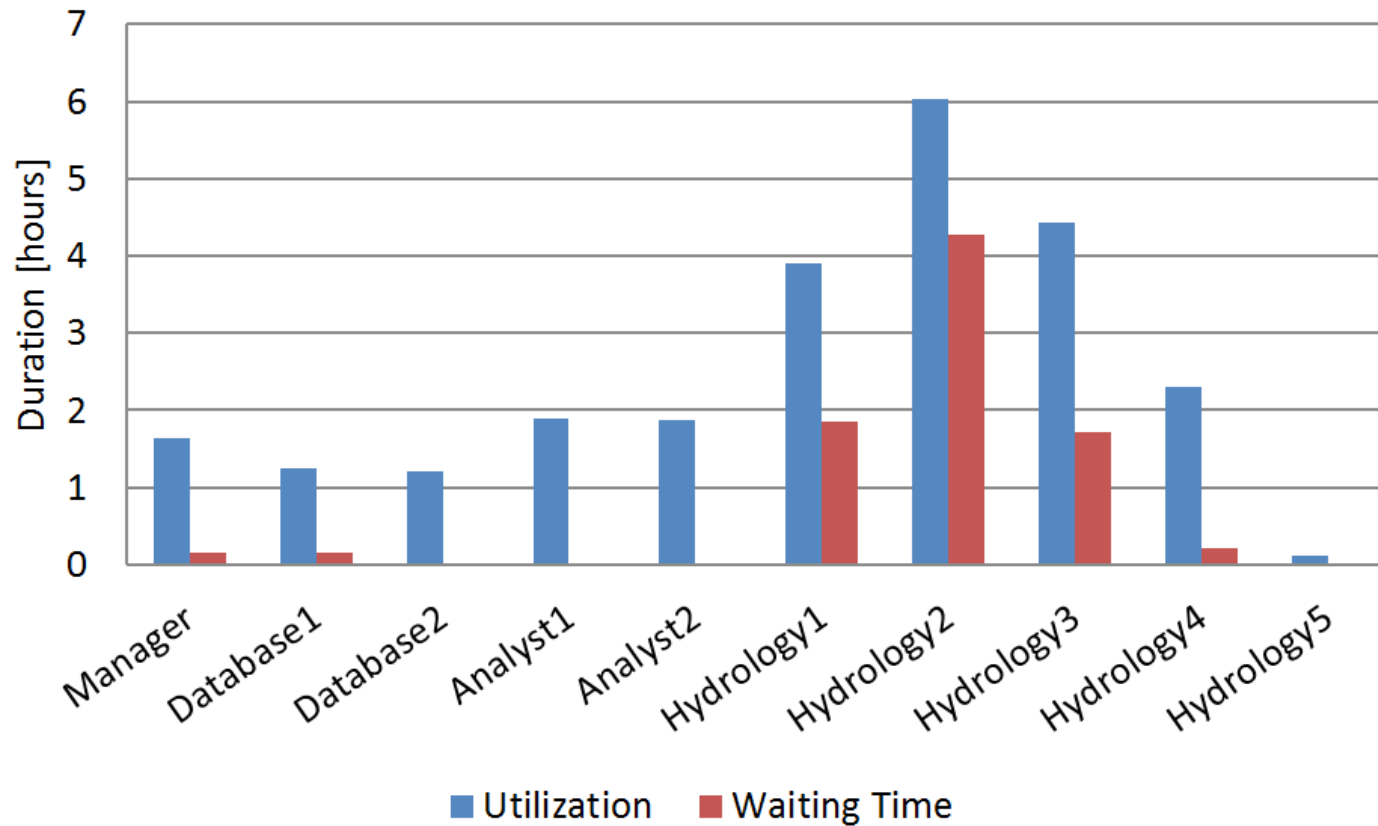
- Flood warning process of the Moravian-Silesian region, Czech Republic
- Focus on the flood warning and forecast stage
- 1 Hydrology manager, 5 Hydrology specialists, 2 Hydrology analysts, 2 Database specialist
- 20 competencies, 10 competency levels, 5 parameters (major catchment areas)
- 200 simulations for each configuration to mitigate unpredictability of stochastic properties



# Case Study Utilization



- Total process duration – 9 hours 44 minutes



# Case Study Improvement



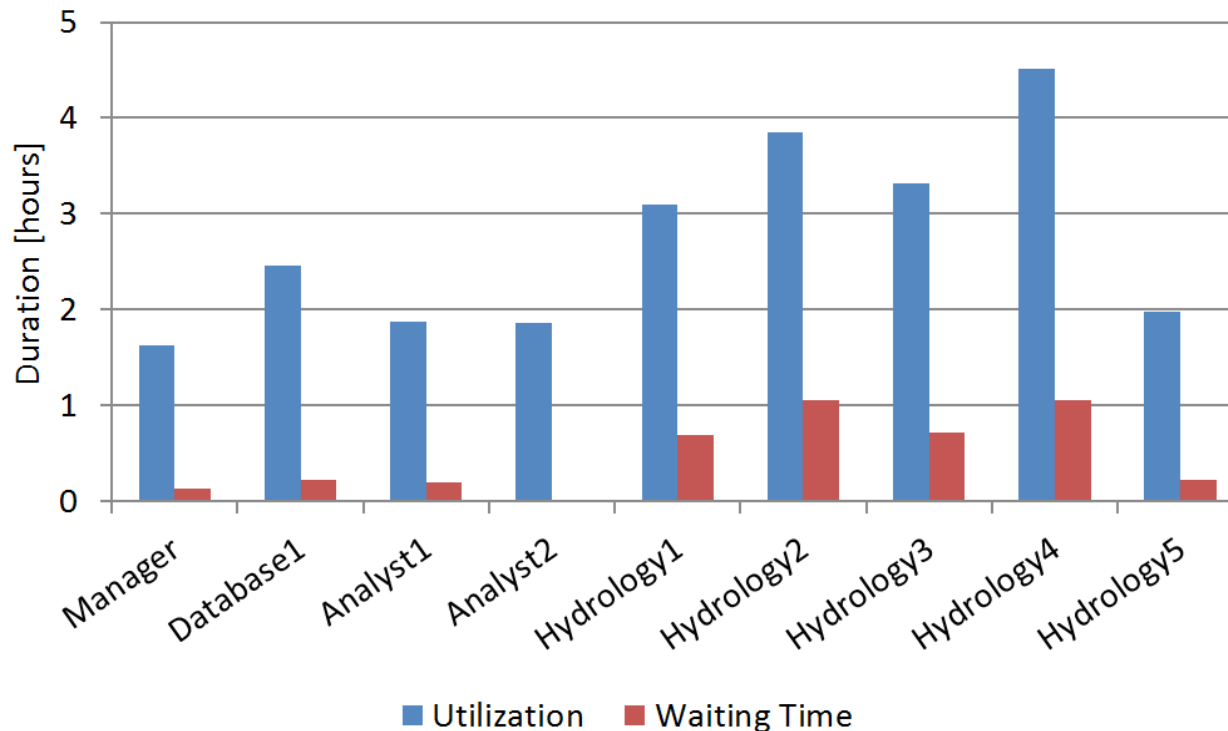
- Database specialist 2 removed
  - Utilization is scattered through the whole process
- Analysts can not be removed because they complement each other with their skills
- 2<sup>nd</sup> specialist's waiting times are caused by one activity – Calibration of the hydrodynamic model
  - 4<sup>th</sup> specialist is only slightly unsuitable for this activity (36% suitability to 39% required)
  - Training this specialist 1 level in either Hydrodynamic modelling or Hydrodynamic calibration is enough



# Case Study Improvement



- By training the 5<sup>th</sup> specialist in one competency, he can also help with some activities
- Duration after improvements – 8 hours 11 minutes





# Conclusion



- Simulations extended with the competency-based specification of resources can be used to support management and training decisions
- Final duration of the process can be further improved by hiring new specialists
  - Hiring one specialist shortens the duration by additional 37 minutes
  - Hiring two specialists by 50 minutes
- Suitability can be also used to influence the performance of the resource





**Thank You for Your Attention**

