Title of the project:
Using expert elicitation to qualify and quantify the uncertainty in the discharge distributions at the Dutch river Rhine bifurcations

Assignment no.: 6.18	**Internal/external:** Internal
Head graduation committee: Prof. dr. Suzanne Hulscher	**Daily advisor:** Matthijs Gensen, MSc (UT) Dr. Jord Warmink (UT)
Name(s) of participating companies or institutes: Various: companies, waterboards, rijkswaterstaat	**Start of the project:** a.s.a.p.

Required courses:
River Dynamics, Hydraulic Engineering

Short description and objective of the project:
1430 kilometers of dikes protect the Netherlands from potential flooding from the Dutch rivers. The main dynamic load on these dikes are river water levels. The nearly completed Room for the River project consisted of 34 river interventions to reduce the river water levels at critical locations. Their effects were studied deterministically despite inherent uncertainties. This uncertainty is dominated by the discharge distribution over the river branches at bifurcation points, which is in turn influenced by various other uncertainties. As a part of the All-Risk research programme the uncertainties in river water levels as a result of an uncertain discharge distribution are quantified. Knowledge of these uncertainties is essential in future planning of river interventions for flood defence reliability.

That research focusses on three main sources of uncertainty: variations in main channel roughness due to the presence of large-scale bed forms, regulation structures at the river bifurcations and large-scale river engineering works such as the Room for the River projects. However, many more processes and uncertainty sources are known to affect the discharge distribution (Ten Brinke, 2013), such as: wind, discharge wave shape, local breaches in the flood protections and long-term morphological changes. Rough estimates of the variability of the discharge distribution due to these sources have been made for design conditions. However, under the new probabilistic risk framework in the Netherlands the wish is to extend the knowledge on uncertainties to other conditions as well. It is very likely that the discharge distribution differs as a function of discharge.

Therefore, the goal of this research is to quantify the uncertainty sources affecting the discharge distribution at a river bifurcation as a function of discharge using expert elicitation to improve river planning and maintenance strategies. In this project, the student will setup and execute and expert study in which several experts from companies, waterboards and Rijkswaterstaat are interviewed. These interviews are then analysed and the expert opinions are aggregated. For this project we are looking for a student with good communication skills and willingness to visit experts throughout the Netherlands. Comprehension of the Dutch language is beneficial.

The research can be broken down in several steps:

1. Review the expert elicitation method by Warmink et al. (2011)
2. Set up interviews and select experts.

3. Plan and execute the expert elicitation
4. Assess the results of the interviews and combine them in a comprehensive manner

Figure 1: The two major bifurcation points of the River Rhine; Left: Pannerdensche Kop; Right: IJsselkop

References

Ten Brinke, W. (2013). *Fact Finding afvoerverdeling Rijntakken*. Tech. Rep., pp. 1-94

Warmink, J.J., Van der Klis, H., Booij, M.J. and Hulscher, S.J.M.H. (2011). "Identification and quantification of Uncertainties in a Hydrodynamic River Model Using Expert Opinions." In: *Water Resources Management* 25, pp. 602-622.