SIMULATION OF WATERWAY INFRASTRUCTURE

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ABSTRACT

Since 1990 Rijkswaterstaat (part of the Dutch Ministry of Infrastructure and Water Management) has used SIVAK, a simulation system to analyze ship handling of traffic at locks, narrow waterways and other waterway infrastructures. Among else it can be used to investigate risks in extreme situations on the waterway. Recently, SIVAK has been redeveloped by Systems Navigator, Witteveen+Bos and MARIN, in state-of-the-art object-oriented simulation software (SIMIO). The Simio model works seamlessly with Systems Navigator's Scenario Navigator SAAS platform allowing Rijkswaterstaat to run SIVAK as a web-based solution available to users from any location, including simulation model execution, animation, scenario management, KPI reporting, debugging, documentation & scenario comparisons.

1   ABOUT SIVAK

SIVAK is a simulation system that has been in use by Rijkswaterstaat since 1990 to analyze ship handling of traffic at locks, narrow waterways and other waterway infrastructures. The system takes into account the effects of the traffic composition and traffic flow, operating strategy and traffic control, etc. Typical results from this model are visualizations on waiting times, utilization of waterways, waiting costs for different ship types per section of the waterway. The model calculations form an important basis for the MIRT (Dutch Multi-Year Plan for Infrastructure, Spatial Planning and Transport) in order to identify and prevent future bottlenecks, while also being applied when developing a new infrastructure.

2   THE NEW SIVAK

The old SIVAK was built in the programming language PROSIM which is no longer supported. Maintenance and further development of the tool became a challenge due to its design and technical execution. As Rijkswaterstaat relies very much on this tool, they started looking to include a new and more modern tool that could expand their capabilities. The biggest challenge for this project was to transfer the concepts and ideas that were developed in SIVAK in the past into the latest object-oriented simulation software. The new model build in Simio brings many opportunities to improve the design, and model generation and population while making SIVAK a state-of-the-art simulator. The Simio model works seemlessly with Systems Navigator's Scenario Navigator SAAS platform allowing Rijkswaterstaat to run SIVAK as a web-based solution available to users from any location, including simulation model execution, animation, scenario management, KPI reporting, debugging, documentation & scenario comparisons.

3   AGILE DEVELOPMENT

The traditional method to simulation model development is the waterfall approach, starting with design, build, test followed by documentation. For the new SIVAK the Agile development method was used instead, resulting in close cooperation during the project, with high engagement from all stakeholders.

4   EXAMPLE PROJECT

To demonstrate the capabilities of SIVAK to fellow simulation practitioners, a typical case study is presented on an existing lock complex in the Netherlands that consists of multiple lock chambers, and is used by a combination of commercial and recreational vessels.

5   FUTURE DEVELOPMENT

Rijkswaterstaat intends to keep using SIVAK at least for another 28 years. In the coming period SIVAK will be extended with new functionality on network planning, KPI reporting, result comparisons & lock management. As SIVAK is a generic model deployed on the internet, it will become available for international users, to be used to assist in the development and management of water networks across the globe.

6   ABOUT RIJKSWATERSTAAT

Rijkswaterstaat is part of the Dutch Ministry of Infrastructure and Water Management and responsible for the design, construction, management and maintenance of the main water infrastructure facilities in the Netherlands. The Dutch waterway network and water systems consist of 300+ locks, 1,000+ bridges & 500+ ports and is considered to be the most complex water transport system in the world.

7   ABOUT SYSTEMS NAVIGATOR

Systems Navigator is an independent consultancy company based in Delft, The Netherlands. Systems Navigator specializes in the design, development and implementation of planning, decision support and digital twin solutions based on operations research technology. Our expertise relies on the use of both discrete event simulation, as well as optimization for decision support models that can predict future system performance. Additionally, digital twin systems can be used for operational decision making and/or planning and/or scheduling. Systems Navigator successfully delivered over 250 simulation projects specializing in capacity studies in port operations and waterways.