DOT.PRO: PROACTIVE MANAGEMENT OF WATERWAY MAINTENANCE PROJECTS

by

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EXTENDED ABSTRACT

DEME's company De Vries & Van de Wiel is executing a 5-year maintenance contract for the inland waterways of the Dutch region 'West-Nederland Zuid'. Due to the uncertainty in the morphological evolution of river and channel beds, typical management of such a maintenance project requires an intensive use of survey campaigns in order to prove compliance and decide when dredging is required. Hence, for this reactive approach on management, the risk of non-compliance depends on the frequency of surveying. Moreover, the inaccuracy of estimating the optimal dredge date and depth leads to an increased number of dredge deployments when adopting a precautionary approach, hence leading to additional costs as well as increased hindrance towards ongoing waterway traffic in the river network.

In addition to the aspects mentioned above, the current project involves the planning and execution of activities such as dredging, bathymetric survey, rock dumping, soil investigation and retrieval of submerged objects, over a total length of about 160 km of inland waterways. The vastness of the project area as well as the great number of contract areas (200+) each with different specific navigational criteria (bed level, tolerance interval and maximal area of exceedance), feed the need for a simple and clear overview of all key parameters that are relevant for operational management, accurately informing a number of different functions within the project team. On top of this, the multitude of operations require an accurate follow up in order to be able to timely inform the client on the current project status concerning all operational and compliancy aspects.

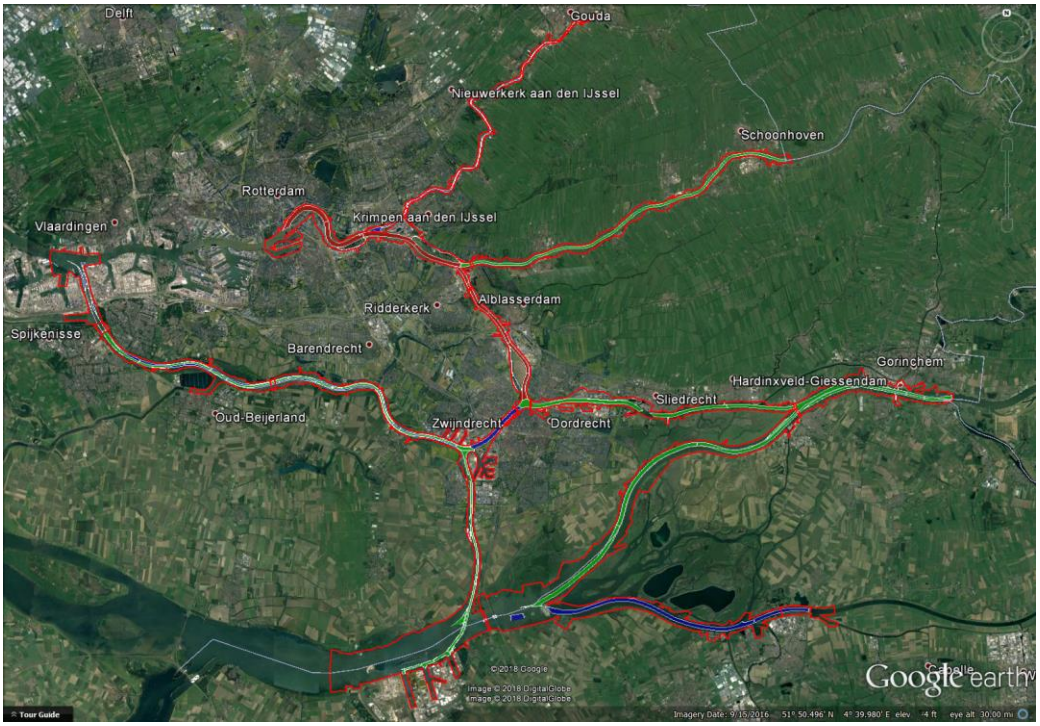

Figure 1: Project boundaries over the river network

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The combination of the above issues creates the opportunity and even the necessity to implement an integrated management approach. Integration, meaning that different parameters (measured as well as predicted) and aspects that are key for the overall operational management can be accessed at any location, at any time, in a simple, intuitive and well-structured manner. Therefore, an interactive website serving as an ever-up-to-date information platform facilitates these needs by becoming an operational interface for the project management team. By doing this, it provides adequate input to make decisions in managing the operations, rendering it an effective online decision tool, named **Dot.PRO**: DEME's Online Tool for PROactive operational management.

The key asset behind the proactive approach is the use of operational modeling practices. After all, computers have become much smaller, more powerful and better connected over the past decades. This technological improvement can benefit the dredging business in many ways, among others through:

- Easier, faster and larger measurement campaigns
- Powerful software models providing faster and better predictions
- Direct access to large (measured and modeled) datasets

Hence, to timely and efficiently deploy dredge equipment on the project, and eventually minimize survey and dredging efforts, regular predictions of the channels' bottom levels are modeled via state-of-the-art proprietary software. Such morphological modeling is performed every month, predicting the project's waterways' bottom levels for the coming 6 months with a frequency of 1 result per month. The hydrodynamic and morphological (Delft3D) model used for the project is an extension and improvement of an existing model made available by the Deltares Institute and the Dutch government (Rijkswaterstaat). The model grid consists of 10 subdomains and covers a vast area, comprising almost the entire network of river branches in the Southwestern part of The Netherlands.

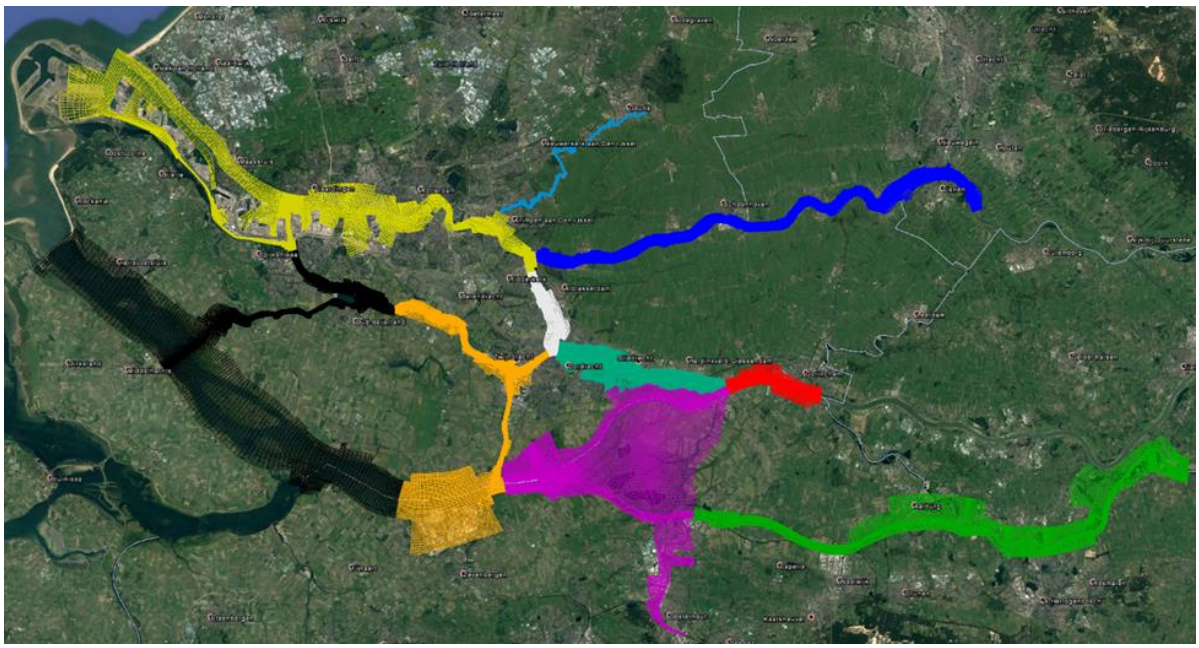

Figure 2: Grid of the morphological model used for the project

In order to meet the intended purpose a balance is needed between the accuracy of the model and the computational expense. To reduce the computational expense a software shell is available that combines the results of multiple sequential model runs each with a distinct constant discharge. The combination of such discharge classes, basically called a hydrograph, has been adapted to better fit the multi-annual discharges into the project domain by discretizing it in smaller steps. The morphological factor (enabling shorter run times by separating the morphological impact from the hydrodynamical runtime) of the model has also been reduced to enable a higher temporal resolution (three steps per month instead of just one).

Before the model could be put in production mode, an important additional improvement has been implemented. As the depth of the river beds change during the project - naturally as well as due to the project's activities - the model's initial bathymetric surface needs updating as well for every new run each month. Therefore, the system has been devised to allow for the automatic creation of a monthly initial bed from a combination of new surveys and model results (in waterways where no recent survey data is available). Once such a production cycle has been set up, it is important to regularly recalibrate the model to gradually improve the accuracy of morphological predictions over the diverse range of flow conditions and riverine areas of the vast project site. Further validation and calibration exercises have started and will be an ongoing process throughout the project's lifetime.

After upload to the system's database the newly modeled predictions are automatically compared with the imposed criteria for every contract area that must be maintained. The platform provides priority dates before which each of the targeted maintenance contract areas must be dredged in order to comply. The results are summarized on a dashboard that presents the order of dredge priority of all the project's waterways, each consisting out of a number of contract areas. The dashboard acts as a timeline integrating all past, ongoing and planned activities and allows comparison with any operational deadline, which for dredging can be set to the model priority date.

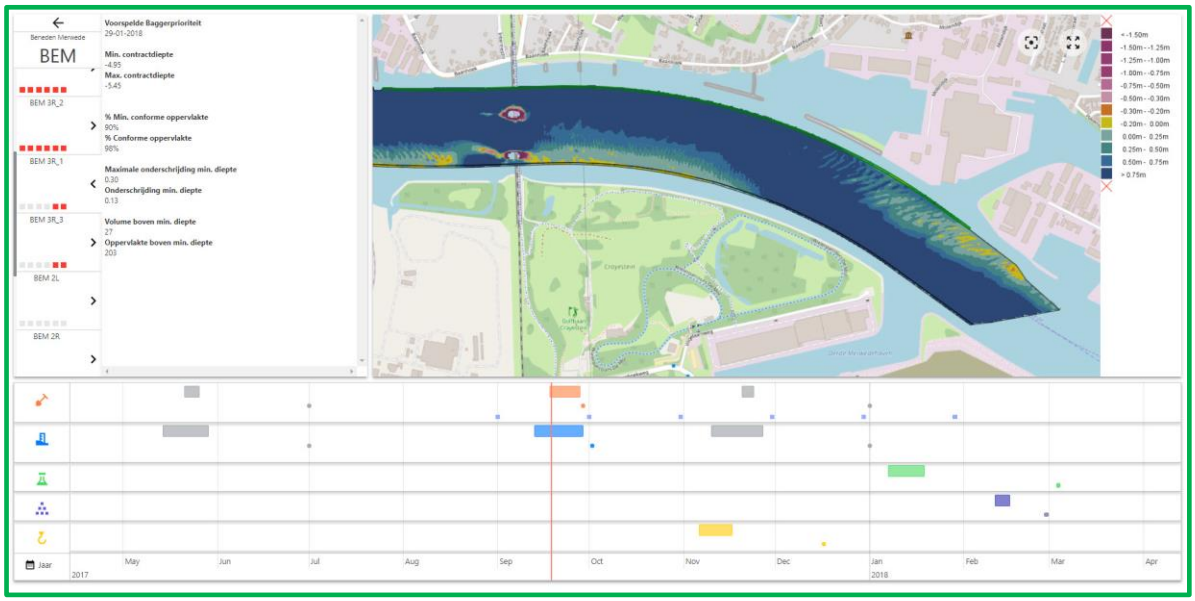

Figure 3: Dot.PRO waterway GUI

For every type of activity, the dashboard can display the order of priority for execution. For survey campaigns, the survey data can also be uploaded to the database and compared with the relevant contract criteria. From the dashboard the user can zoom in on a specific waterway, providing easy access to all relevant limits and parameters per contract area in relation to any of the bathymetric predictions as well as any survey data, such as the required surface and volume to be dredged on the predicted date. An interactive GIS module displays a geographic overview of the whole waterway, and any of the predicted or surveyed bathymetric charts in relation to the contract levels. A detailed timeline allows the project team to easily keep track of all required operations and adjust planning accordingly. Many features are clickable and provide easy access through this intuitive graphical user interface.

The devised online integration of what, when, where, and why actions must be taken, results in an optimal proactive approach of waterway maintenance works. This includes facilitation of the decision-making process, easy data access to any stakeholder within the project team, and timely and optimal intervention of dredge vessels and other equipment, therefore also reducing hindrance towards ongoing waterway traffic. By granting access to the platform, the client is provided with an online up-to-date reporting tool, facilitating transparency and confidence in proper management and execution of the project.