The Port of Rotterdam (PoR) is a leading global port and by far the largest seaport in Europe—in 2013, more than 130,000 vessels shipped about 440 million tons of cargo through the port. For many goods, PoR is the initial entry point to the European market, which consists of more than 500 million consumers.

PoR is geographically constrained and completed a large-scale €1.35 billion expansion in 2013 to meet the projected increase in port traffic. The project, Maasvlakte 2, in the North Sea added 2,000 hectares of land behind a 4-kilometer dike. Growing within its geographic limits while remaining competitive requires good accessibility by water, train, road and pipelines. At the same time, this growth needs to balance the interests of the community and environmental regulations.

Recognizing that this would require optimal and more efficient use of existing assets, PoR decided to invest in a new spatially enabled framework to support performance-based asset management. The platform, based on a geographic information system (GIS), would replace their existing, typically home-grown systems, which were technically obsolete, expensive to maintain, and unable to connect to mobile devices and business systems used across the port.

**A Goal of Three Mouse Clicks**

The port authority wanted a platform so user friendly, any user could find information for their role at the port within three mouse clicks. They also required an adaptive system to handle facilities management, accommodate mobile devices and integrate with its other corporate information systems: SAP, Microsoft (Sharepoint) and e-docs. PoR also required more of a partnership than a traditional provider-client relationship, especially as the system expanded.

In the first phase, Esri Global (Redlands, California) helped PoR implement ArcGIS and integrate it with key enterprise business systems, such as SAP, AutoCAD and Microsoft Office. Esri also built an enterprise geodatabase that houses more than 150 data layers, including port assets, boundaries, parcel land records, utilities data, transportation data, bathymetry, ortho-imagery, nautical charts and lidar data.

The final data model, a combination of asset management data, land records and nautical data, is unified through the application of configured extract-transfer-load (ETL) scripting that automates the daily ingestion of updated information into a common picture, which informs the business of the port. In one example, more than 700 electronic naviga-
Implementing Charting and Bathymetry Solutions

Understanding the depths throughout the port is a critical piece of information for the PoR’s day-to-day work. Since PoR is in a constantly changing riverine environment, surveying regularly is vital. Esri Global used the ArcGIS for Maritime solutions to help manage and utilize hydrographic information in both traditional and novel ways.

Since constant surveying translates into a large amount of data to manage, PoR and Esri Global looked to the ArcGIS for Maritime: Bathymetry solution to develop bathymetric surface models based on filters and rules created using associated metadata. Esri Global helped PoR extract more than 3,500 surveys from their proprietary system, Dolomit, including configuring the metadata of the surveys into a bathymetric information system (BIS).

After the BIS was populated with the historical data, Esri Global worked with PoR to create a daily work flow for adding data sets to the BIS and creating a complete, seamless surface model. The surface model developed with the BIS is used to generate soundings for PoR’s ENC and PortMaps information products for the harbormasters and other data consumers at the port. One critical information product that relies on the surveys is the dredging atlas that compares the information in the BIS to the designed depths to guide dredging efforts in the port.

Asset Management

The first step in implementation is a data model used to describe PoR assets, ranging from small objects to large structures and all administrative/contractual objects. The key point is that everything is tied to this enterprise data model and PoR manages the data through registers: SAP for administrative, AutoCAD for engineering, ArcGIS for geospatial, Microsoft SharePoint for document management, etc.

In addition to these enterprise registers, there are a number of expert systems that support specific business processes with some analysis, visualization, reporting, etc. These systems retrieve or return data from the enterprise systems in the Port Object Information System (POI) data model, but are not used to manage information from these enterprise registers. For users, information from all systems is easily accessible everywhere. If you start in GIS, you can retrieve CAD drawings of the structures and contract documents from DMS, as well as view current revenue/contract duration from SAP. Similarly, if you are in AutoCAD, you can use ArcGIS for AutoCAD to retrieve the geospatial layers.

Esri has continuing work with PoR to implement a lease operation map. With a single click on the map, a business manager is able to see when and where leases expire. As a Web map, it can be accessed from anywhere in the world on any device.

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Since PoR is such a rapidly evolving navigational environment, the port generates its own set of ENCs to disseminate the latest information to mariners. Esri Global and PoR used the ArcGIS for Maritime: Charting and QPS QINSy solution to combine information from various sources and produce ENC cells.

To build the base information of the Nautical Information System (NIS), Esri Global first imported ENC cells from the Dutch Hydrographic Office and then augmented that information with PoR ENC cells and information from the Port Object Information System (POI). Since data editing happens constantly in the POI, Esri and the Port created a workflow for automatically updating the NIS several times per day from the POI authoritative information.

Using the ArcGIS for Maritime: Charting solution, the port is able to export updated ENC cells for the entire port within a matter of minutes. In addition to giving those cells to the pilots and mariners within the ports, the ENCs feed into the PoR maritime chart server. The maritime chart server displays vector nautical charts as query-able GeoServices REST services or OGC Web Map services. That gives the port access to dynamic querying on the rich data contained within ENCs, in order to assist with planning and domain awareness.

**Quay Wall Management**

A key asset maintained by PoR is their system of quays, the fixed walls of concrete, rock, and/or steel plate used for mooring the ships transferring goods. The PoR asset managers also wanted to have a simple way to review their concrete inspection and monitoring results within PortMaps. This required integration of SIMCO’s inspection analysis tools and an easy interface, based on the three-clicks philosophy, to get to the right area and the elevation view of anodes and core results. Esri Global worked closely with PoR and SIMCO to build this functionality, which can also be used in other AutoCAD-based (i.e., paper-space measurements) integrations.

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Captain Guy Noll (retired) leads a group of project managers, solution teams and technical specialists at Esri focused on customer support of GIS implementation across the maritime domain, including port operations and ocean science. Prior to Esri, Noll has more than 24 years of experience in science fleet operational management, hydrographic survey and nautical charting technology with NOAA.

Marten Hogeweg leads a team at Esri that develops products and solutions for spatial data infrastructures, open government and enterprise information sharing programs. He has extensive experience in geospatial industry standards and use of Web 2.0 technologies. He is also the project manager for Esri’s work with the Port of Rotterdam.

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