QINSy

A Total Hydrographic Solution!

QINSy provides a user-friendly, turnkey solution for all types of marine navigation, positioning and surveying activities. From survey planning, to data collection, data cleaning, volume calculations, bathymetric chart production, and S-57 ENC production, QINSy offers a seamless data flow from a large variety of hardware sensors, all the way to a complete chart product. QINSy runs on a standard PC platform under the Windows (2000/XP) operating system. The software is not only independent of sensor manufacturer, but also hardware independent.

QPS

Extreme Versatility - Survey Applications

From scraping diamonds off the seabed to dumping rock on pipelines, from anchor handling to bathymetric or Side Scan Sonar surveys, its modular design and inherent flexibility makes QINSy perfect for a wide variety of applications. For example, it can be configured to perform:

- Hydrographic and Oceanographic Surveys
- Offshore Pipeline Inspection and Pipe-laying
- Marine Construction including Offshore Oil and Gas
- Dredge Monitoring and Support
- ROV and AUV Tracking and Data Collection
- Barge, Tug and Fleet Management
- Bathymetric Chart Production, Cross Section Creation, and Volume Calculation
- S-57 ENC Production

Since its launch in 1996, QINSy has become the standard in marine surveying, bathymetric chart production and ENC production.

Extremely Large Sounding Grids

The key technology developed by QPS is based on the collection and presentation of large volumes of navigation and depth data, all in real-time to produce almost final results on-the-fly. A powerful Sounding Grid (SG) is used for on-line presentation and off-line processing. The SG comprises multiple levels with a different resolution per level based on the quadtree technique. Only the highest resolution level need be defined; all others are produced automatically. The other resolutions (e.g.1m x 1m, 2m x 2m, 4m x 4m, 8m x 8m, etc.) are used for faster display purposes, and also to define the resolution of data exported from the Sounding Grid.

The SG has no boundaries and is therefore unlimited in size! In the Sounding Grid Utility (SGU) the user has only to define the base cell size (highest resolution). Online the first position recorded is used as origin.

Multiple layer support allows simultaneous storage of different data types to different layers. For example, multibeam data is stored in one layer, side scan sonar data to another, magnetometer data to a third layer and singlebeam data, pipe tracker data, dredger production value and/or any other system to additional layers in the same SG. During on-line navigation, displaying a combination of two layers is possible. This allows for draping side scan sonar data over multibeam bathymetric data, or dredge production volumes draped over bathymetric depth, or theoretical profile.

QINSy Survey

QINSy is based on a "no limits" design criterion, benefiting the user in supporting an unlimited numbers of vessels, sensors, computations and displays, and in making modifications and future developments easier and cheaper to achieve The key technologies behind the success of QINSy are based on precise navigation, data acquisition, presentation, storage and processing of large volumes of data all in real-time to produce almost final results on-the-fly.

QINSy Survey is the heart of the QINSy product portfolio. This package is used for Survey Planning, Data Acquisition, Processing and Data Cleaning. Add-on modules extend basic package functionality. Modules include:

- Multibeam support
- Side scan sonar and sub-bottom profiling support
- Dredging support
- DGPS QC functionality
- S-57 ENC update functionality
- Qloud
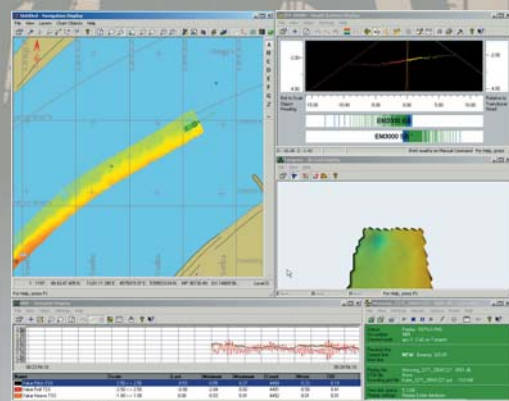
Great Flexibility -Sensor Support

A very large number of sensor I/O drivers have already been developed over the past years. QINSy comes standard with over 600 field-tested I/O drivers, so, in most cases, it handles all your hydrographic related sensors right out of the box. If an existing driver does not meet your need, the *I/O Driver Utility* usually lets you write your own driver. Failing that, the modular design of QINSy allows QPS to write additional drivers quickly.

QINSy supports the following sensor types:

- Singlebeam, Multibeam Echosounders and Mechanical Profilers
- Motion Sensors, Gyros and Compasses
- GPS, DGPS, RTK and Total Stations
- Side Scan Sonar, Sub Bottom Profiler and Magnetometer
- Dredge Monitoring, Auto Pilot and DP Systems
- USBL and LBL systems
- ARPA and AIS functionality
- Generic Sensors (analog, weather, rpm, environmental)
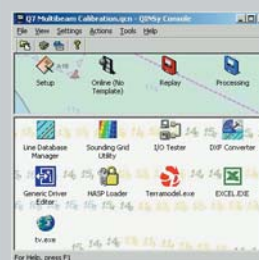
The *Console* is your starting point in QINSy Survey. It makes navigation through the program suite very intuitive at each phase of the project. You are guided through the various program modules designed specifically for survey planning, data collection, data processing and chart production. The *Program Manager* provides a complete overview of project status at each phase.

Comprehensive Survey Planning

Created at the planning stage with the *Setup* program, a *Template Database* contains all survey configuration parameters pertinent to the project. QINSy supports most of the World's datums and projections (including predefined US State Plane System coordinate systems), multiple units and geoidal models used world-wide. The template contains vessel shapes, administrative information, as well as vessel offsets and I/O parameters. It is a complete reflection of your current survey set up and fully editable to kick-start your next project.

Background Display

Drawing files generated from CAD programs often contain more recent and more accurate information than electronic navigation charts. QINSy allows import of DXF, DWG and PRO files. To ensure speedy refresh rates of real-time displays, DXF and DWG files are converted with the *DXF Converter* at the planning phase. These binary files are displayed as an overlay to S-57 ENC charts in the Navigation Display. QINSy supports both S-57 and *CM93v3 Electronic Navigation Charts*.

The use of satellite images, aerial photo's or any other *geo-referenced bitmaps* in the Navigation Display gives another dimension to your area of interest.

Sounding Grid Utility

A Sounding Grid to be used during data acquisition is created in survey planning. Grid cell size, the statistics to be recorded per cell and the layers required to store the various data acquired online are all defined at this stage. No boundary definition is needed, and file size is no longer a software issue, the limits now being attributable to processing power, memory available and hard disk capacity.

The Sounding Grid Utility (SGU) is populated online with various data, all of which can be accessed offline in post processing. With support for ENCs, GeoTIFFs, and DXF background files, waypoint planning functionality in the utility is used during survey planning to design survey line layouts.
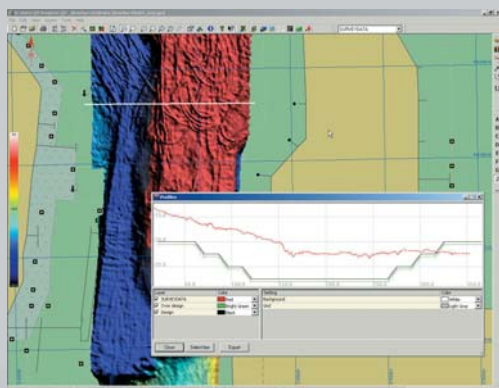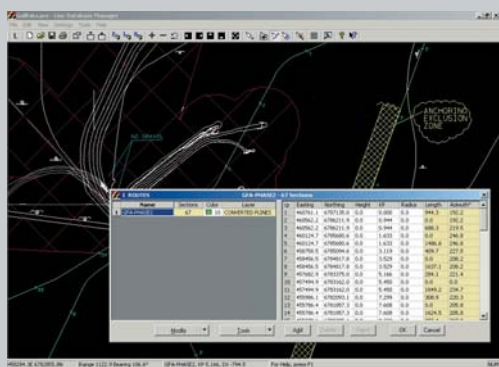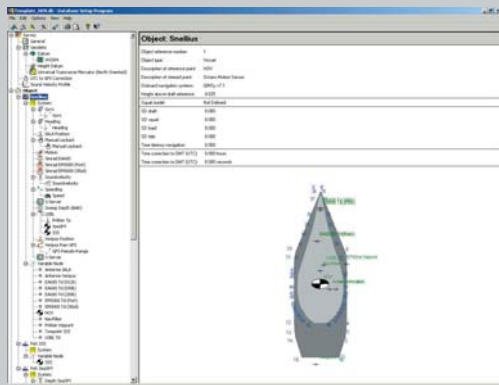
The *Line Database Manager* is a comprehensive tool-box for survey planning, allowing the surveyor to manually define, automatically generate and/or import from ASCII and DXF files, the following line types:
- Targets and Symbols
- Single Lines
- Survey Grids
- Routes
- Wing Lines
- Cross Lines

Data can also be exported to:
- ASCII
- DXF

The Line Data Manager works interactively in real-time with the Online Navigation Display where points, lines and routes can be generated right in the Display during data acquisition.
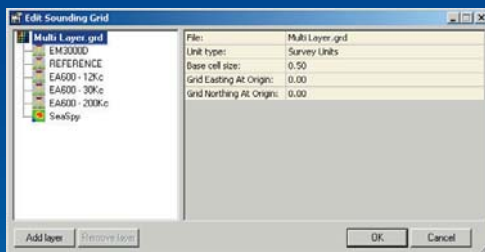
Real-time Final Results -Data Collection and Output
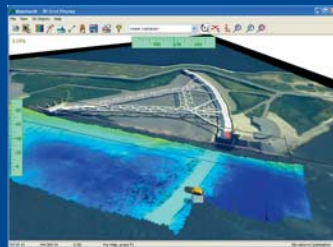
Raw Sensor Data

All raw sensor data is logged and permanently stored in fast relational data-bases (*.db) to each of which the entire survey configuration is copied from the template. Raw data can be analyzed and edited using the *Analyse* program, making it ready for the *Replay* program and generation of new results if that is necessary.

Accurate Timing and Ring Buffers

Accurate timing is imperative in many survey situations. QINSy uses a very sophisticated timing routine based on the PPS option (Pulse Per Second) available on almost all GPS receivers. All incoming and outgoing data is accurately time stamped with a UTC time label. Internally, QINSy uses so-called "observation ring buffers", so that data values may be interpolated for the exact moment of the event or ping.

Real-time DTM Production

All computations of position are performed in 3D. In combination with RTK or real-time tide gauges, this means that all depth obser-vations are immediately available in absolute survey datum coordinates. This unique tech-nique is called "on-the-fly DTM Production".
QPS was the first company introducing the "delta heave" method, which means that the quality of the final DTM is no longer affected by heave drift caused by vessel turns.
Gridded point data output to the Sounding Grid is paralleled by an output of ALL soundings to a second file (*.qpd,*.sds,*.fau,*.pts or other). Either reduced or full datasets are available for further DTM processing.

Data Storage

How raw and results data files are split up during acquisition is your choice. Data may be stored on a line-by-line basis, by file size, or by manual inter-vention. Whatever the method, data are normally stored in several separate databases for convenience in processing.

Enhanced Functionality - Getting the best out of your system

Side Scan Sonar

Backscatter from most modern multibeam systems (called 'snippets') and/or true Side Scan Sonar data, is mosaiced in real-time, geo-referencing being performed using a flat bottom assumption, or, better still, using a full 3D terrain model. In addition to the waterfall display, this geo-referenced backscatter data, and/or data from dedicated side scan sonar sensors, is presented in real-time as a mosaic in one layer of the multi-layered sounding grid, itself one of the layers in the multi-lay-ered Navigation Display. QINSy offers advanced real-time SSS target detection, meaning that SSS processing time is cut down to almost zero. A dedicated SSS data viewer supports loading, viewing and performing target detection is just seconds.
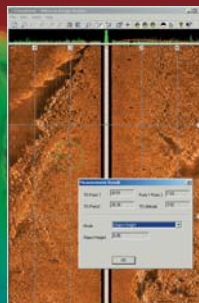
Eventing

Used in many survey operations like pipe-laying, pipeline inspection, and buoy tendering for example, *Eventing* is a powerful feature in QINSy. Completely user-configurable, all events, and classes of events are defined in planning. Using the resultant Event Tablet online, events are easily generated with a single mouse click, with each event log stored in real-time.

Use of Multi Layer Sounding Grid

For multibeam surveys, "gridding" is the predomi-nant data reduction method. However, achieved reductions usually mean a loss of resolution. In QINSy a regular multi-level gridding method is used. Based on the minimum cell size, 5 additional grids are generated on-the-fly. Grid file size is no longer an issue, since there is no limit to the number of grid cells. If the minimum cell size is selected to be 1x1 meter, then the following grid levels are automati-cally generated; 2 x 2, 4 x 4, 8 x 8, 16 x 16, 64 x 64 being the overview level.
The method used in QINSy ensures faster update of navigation and 3D displays (only show the resolution which fits to the viewing scale and screen resolu-tion), smoother contours using larger cell size without loosing data and provide the user direct access to various resolution levels without the need of replaying the survey data.
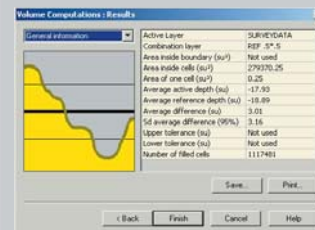
Beside the availability of multiple properties per cell such as mean value, minimum value, maximum value, value count, standard deviation etc, the user has access to create multiple layers into the same sounding grid. Data from multiple sensors can be recorded into the same sounding grid, at the same time, but on different layers. The user can toggle easily between the different layers and/or can set up multiple navigation displays showing different Sounding Grid layers. It is also possible to combine two layers, allowing the user to view, for example, Side Scan Sonar data draped over the multibeam echo sounder data in real time!
Sun illumination of the sounding grid layer opens the eyes of the user. Small items and difficult to find pipelines suddenly show up when using the colored sun illumination option on your data.
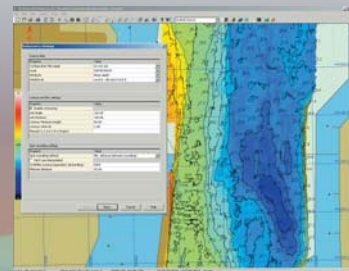
In post processing the recorded data can be viewed and edited using the special developed sounding grid utility, the user has the ability to perform;
- Improved Volume calculation between two layers with or without tolerance levels (Over dredge design);
- Quick cross profiles through Sounding Grid;
- GeoTIFF images can be exported for use by QINSy online, or by 3rd party software;
- Depth contours and spot soundings can be generat-ed and exported to both S-57 ENC and DXF;
- Combining several layers (draping);
- Waypoint and single line planning;
- Overlay of DXF and PRO files;
- Sun Illumination and shade exaggeration to high-light seabed features;
- Full control over statistical information regarding data recorded in each layer;
- Manual editing of sounding grid entries

The Multilayer Sounding Grid can be used not only for bathymetry, but also for SSS Mosaicing, magne-tometerdata, seabed classifications, dredging pro-duction etc.
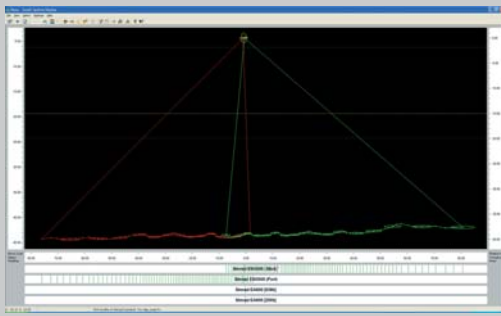
Total Propagated Error

So that our users could qualify their data in real-time according to IHO S-44 provisions, QPS implemented TPE (Total Propagated Error) functionality, sometimes referred to as 'error budget'. The TPE of a point is a measure of the accuracy to be expected for that point, when all relevant error sources are taken into account.
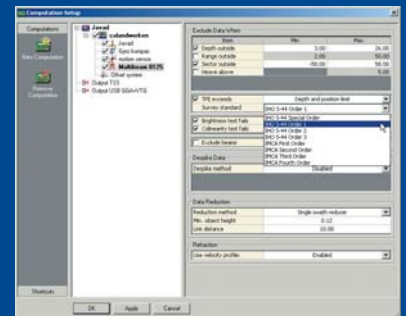
For example, the TPE of a computed DTM point on the seafloor, comprises the propagation of the individual errors of the echosounder system, motion reference system, sound velocity system, positioning system, heading system, ships offset system and other systems which contribute to the total propagated error.
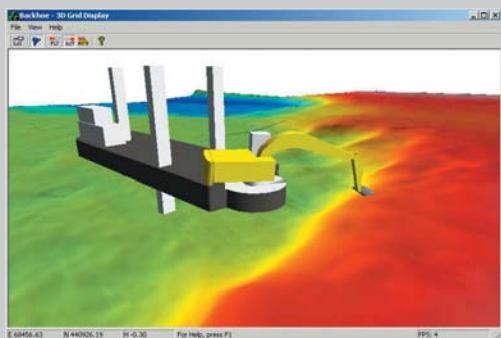
Advanced Dredging Functionality

Advanced dredging functionality to control and monitor dredging operations in real-time is available as an add-on module to QINSy Survey. The available sensors on board the dredger are integrated in QINSy and used to calculate not only the exact location of the dredge tool, but also perform TDS and production calculations.

The Profile Display is used to visualize in real-time, the dredge tool relative to the various DTM layers containing, for example, current survey depth and theoretical profile. The dredge tool object shape (dredge head, bucket, etc.) is viewable from different angles. The Profile display shows the distance between the object and each of the DTM layers with an update rate of up to 10 times per second.

The entire dredge process can also be monitored using the powerful real-time 3D display, employing multiple perspectives from different camera views. Hopper dredgers, cutter dredgers, backhoes and other dredging tools are seen moving in a 3D environment at the same time that the dredged depths are updating the multi-layer sounding grid, all in real-time.
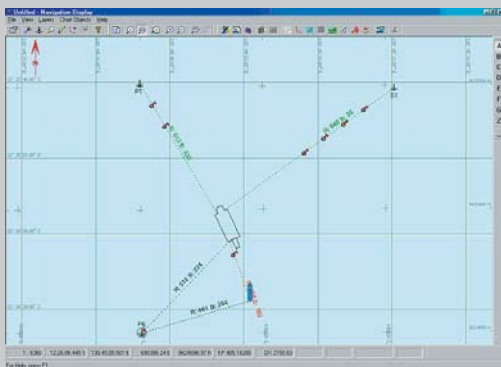
Anchor Handling &Barge Monitoring

Advanced functionality is used to monitor tugboats relative to a rig/barge and the local environment from one location. Data transmission between rig/barge and tugboats ensures anchor pattern exchange between the vessels. A special Tugboat Display program, requiring no surveyor, runs on each tugboat, providing continuous geographic context of position and target information for the required task.

For ease of use, anchor locations can all be positioned by click and drag of the mouse on the navigation display!

Quality Management System

A Quality Management System (QMS) provides both surveyor and processor with full insight into the calibrations performed, and the settings used, from start of survey (calibrations) to end (validation of data). The following main features are recorded in the QMS:
- Start and end time of each survey line;
- Sound velocity profile;
- Alerts such as roll, pitch outside limits;
- Data cleaning tools and de-spiking used both on-line and off-line (Validator)
- Position check through Establishment Fix routine;
- Gyro and Height calibration;
- Tidal stations used in the Tide Processor;
- Comparison between a (single beam) reference line and another (single beam)survey line;
- Statistical information of data recorded in Sounding Grid

OBC-Seismic support

QINSy provides full support for the execution, monitoring and controlling of the OBC Seismic operation on both the recording, and the shooting, vessel.

On the shooting vessel, QINSy provides general navigation, positioning of the on-bottom streamer by means of a USBL system, and interpolation of hydrophone group positions.

On board of the airgun vessel, QINSy is used for general navigation, triggering of airguns at predefined positions (including user defined preload) and positioning of airguns.

QINSy can export and merge navigation records from the shooting and recording vessel using the UKOOA P1/90 format.

# Speedy Processing - Data Validation, Editing, Calibration and Tide Reduction

Data Cleaning

Employing various real-time data cleaning tools and correcting for motion, tide and refraction, QINSy is designed to output almost final results at the time of data acquisition. Moreover, the many quality assurance functions equip the surveyor with tools to qualify results data in real-time. Starting with a cleaner, and thinner, data set effectively reduces time spent in post processing.

The QINSy Processing Manager

All XYZ files are listed in the QINSy Processing Manager, tabulated against a history of processes performed on each file. This provides a complete overview of the project processing status. Processing programs are launched from the Processing Manager:

- The Tide Definition and Processing utility supports various methods for tidal reduction.
- The Validator supports both manual and automated data cleaning including advanced 3D splined surface cleaning.
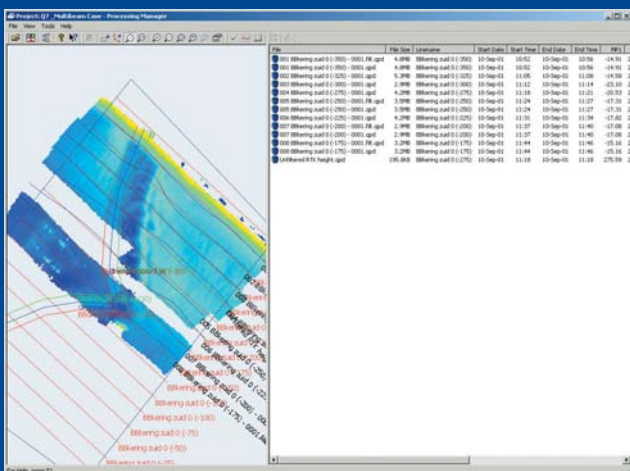
Powerful Side Scan Sonar Functionality

Side Scan Sonar data is viewed and processed with the Side Scan Sonar Viewer Program . It offers the same look and feel as the waterfall SSS Display used during data acquisition. Powerful target detection tools allow you to export targets and geo-referenced bitmaps to the QINSy Mapping database to provide a complete targets overview.
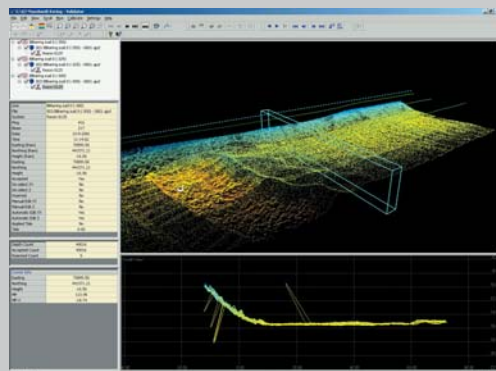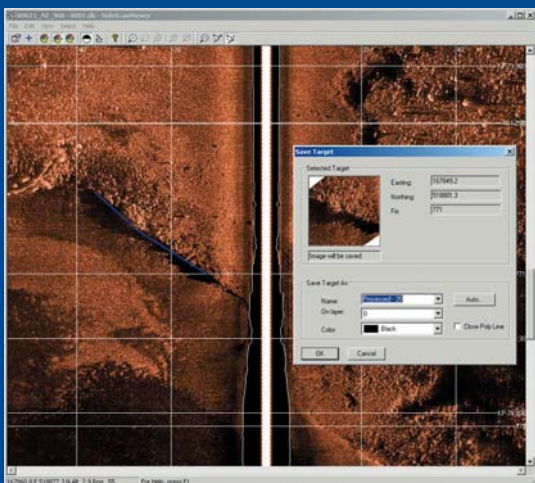

The QINSy Validator

Multibeam exploded the volume of point data and created data handling challenges both in the acquisition and processing phases. The QINSy Validator is probably the most powerful data-cleaning program on the market today. Inherently fast data access allows loading and viewing of millions of points in just seconds. The Validator has 4 different views, 3 of which can be opened simultaneously:

- Plan View
- Cross View
- Profile View
- 3D View

Multibeam Calibration

Multibeam calibration is interactive, and very easy, providing both manual and auto-calibration options. These tools calibrate for errors in:
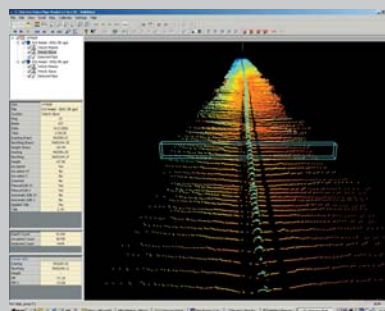

- Roll
- Pith
- Yaw
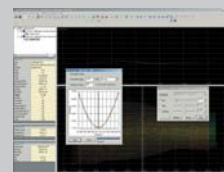
Singlebeam and Multibeam Data Editing

Editing of singlebeam, or multibeam, has never been easier. A variety of automated cleaning algorithms are available:

- Apply On-line Flags
- Clip Below /Clip Above
- Adaptive Clipping
- Median and Mean
- Butterworth
- 3D Spline Surface Despiker
- Multiply/Shift

The Validator adds fully automated pipeline detection features, such as:

- Top of Pipe Detection
- Bottom of Trench
- Mean Seabed Detection

QINSy EPP-57

The QINSy ENC Production Platform 57 distinguishes itself from other approaches to electronic chart production platforms by its efficient way of data storage, and through the principle of semi-static base cells that are easily updated with highly dynamic bathymetric data. The bathymetric data is generated directly from the digital terrain model, itself updated constantly with new hydrographic survey data. This principle allows for a completely updated ENC cell ready for distribution within hours of survey completion. Since the system is built on open Oracle technology, it can be adapted and extended under the user's own supervision. The user makes use of the newly developed ENC Qomposer, an ENC editor for conversion of data to and from the EPP-57.
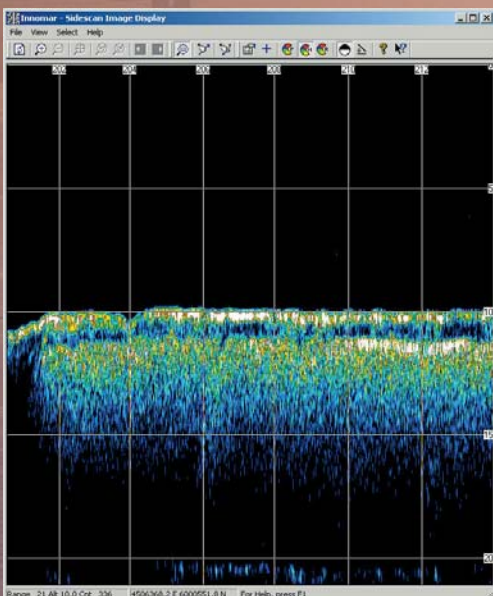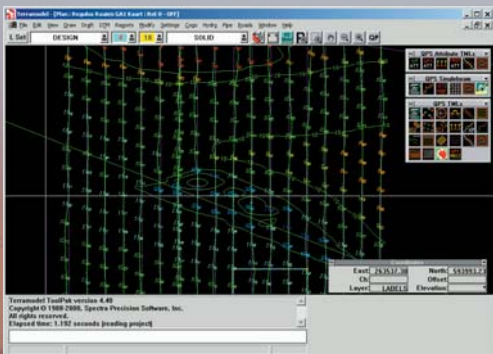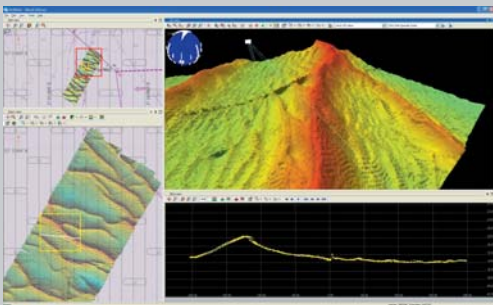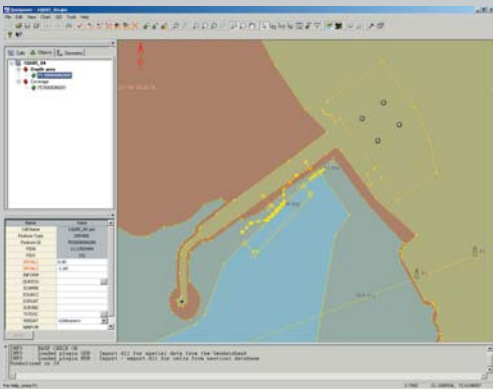
Qloud

Newer generations of multibeam echsounders dramatically increased the number of depth soundings, both in terms of number of beams, and in ping rate. Dual-head multibeam systems providing up to 20,000 depth measurements per second have become a reality.

Despite this increase in data volumes, the QPS philosophy of producing almost final soundings in real-time remains effective. However, as always, there is still a need to validate the online results using off-line tools. The difference is that these ever increasing data volumes require a new offline data analyze tool, ready for the future.

Our new 3D data cleaning tool, called Qloud, is specially developed to handle extremely large areas of multibeam data and to perform statistical data cleaning using parameters such as Total Propagated Error (TPE) in algorithms like CUBE (developed by the Ocean Mapping Group at the University of New Hampshire) and the surface spline filter.

Qloud allows very fast scrolling through the data and instantaneous focusing on the problem areas.

QINSy Mapping

QINSy Mapping is a powerful processing package for the marine surveying and construction industry. With its many task-specific macro utilities, the software performs all necessary calculations quickly and easily, produces plots, generates contours and spot soundings, and calculates precise volumes in just seconds. A dedicated add-on module is available to export depth contours and spot soundings directly into IHO S57 ENC vector chart format. The QINSy 3D Tool generates not only great looking images of the seafloor, but also realistic fly-through video clips ideal for client presentations.