SUCCESS STORIES

Bombardier achieves eight times faster validation of wagon ride and safety with nCode GlyphWorks

BOMBARDIER ACHIEVES 8 TIMES FASTER VALIDATION OF WAGON RIDE AND SAFETY WITH NCODE GLYPHWORKS

Bombardier Transportation is one of the world's leading companies in the rail equipment manufacturing and servicing industry. The company's manufacturing operation in Derby builds passenger rail vehicles for the UK market. The company's test facility in Derby provides independent testing services to rail vehicle owners and operators in the UK, Europe and worldwide. European freight wagons require compliance to a number of rail vehicle ride and safety standards such as the European Standard BS EN 14363. In the past, it took about 160 hours to analyze test data to verify compliance with this safety standard. The data analysis flow typically consists of filtering data, performing frequency analysis, and statistical analysis and generating reports.

Bombardier Transportation now uses nCode GlyphWorks test data analysis software to automate this process, reducing the time required to analyze test data from 160 hours to about 20 hours. In addition to saving time, the automated process provides a very high level of assurance that the data analysis procedures required to validate compliance with the standard have been followed to specification.

"

WE HAVE SUBSTANTIALLY REDUCED THE TIME REQUIRED TO ANALYZE DATA NOT ONLY FOR THIS CUSTOMER BUT FOR ALL FUTURE CUSTOMERS THAT REQUIRE VALIDATION TO THE BS EN 14363 STANDARD

Wendy Smith, Test Engineer for Bombardier Transportation

IMPORTANCE OF TESTING

Testing plays an important role in the design, development and manufacturing of Bombardier Transportation's products. Testing is performed during the development process, in the validation of first-off production vehicles, as part of the quality assurance process after the vehicle enters production, and when vehicles are modified for new markets. The Derby test facility performs static and dynamic testing on all types of rail vehicles by acquiring: stress, acceleration, pressure, torque, displacement, temperature, electrical current and other measurements from a variety of sensors.

Test data is used in many different areas but one of the most important is in the ride and safety certification process required by regulatory authorities around the world. A good example is: BS EN 14363 Railway Applications – Testing for the acceptance of running characteristics of railway vehicles – Testing of running behaviour and stationary tests, which regulates acceptance tests for wagons in most European Union countries. Other countries, including the United States and the United Kingdom use analogous but different methods for acceptance testing. Rail vehicle manufacturers that build products for global use are required to implement test procedures and data analysis methods that comply with the different standards applicable to each country their products are used in.

The Bombardier Derby Test Facility Bogie Rotation rig.
A new UK passenger train undergoing a bogie rotation test, allowing the design engineers to validate the resistance to rotation between the bogie and carbody.

STANDARD REQUIRES FIVE ANALYSIS PROCESSES

The BS EN 14363 standard requires that wagons be tested on both straight and curved tracks at a number of different speeds. Typically about 16 channels of time history data are acquired, primarily consisting of acceleration data in the transverse and vertical orientation on the vehicle body and bogie. The standard requires that the data acquired on the straight and curved tracks and the data acquired for vehicle bodies and bogies be processed differently. This means that these different sets of data require different processes called 'flows' in GlyphWorks. The general ride assessment is based on the vehicle body transverse data channels, while the running safety assessment is based on both vertical and transverse data channels, on both the bogie and vehicle body.

Freight wagon from Irish Rail under test, at Dromod Station in the Republic of Ireland, during ride tests.

There are a total of five different analysis flows for:

- ride instability for straight and curved tracks;
- running safety for straight and curved tracks;
- quasi-static, which only requires a flow for a curved track.

The first step is to extract time histories from the test data consisting of 100 meters of data from curved sections and 250 meters of straight track. A total of 14 kilometers of test data is selected including 40 straight sections and 40 curved sections with each of the time histories going through a low pass filter. An example of the differences between the flows, the channels acquired from the bogie are processed with a particular low pass filter while the vehicle body channels go through a different filter, as defined by the standard.

MANUAL DATA ANALYSIS WAS TIME-CONSUMING

The next step is removing the extreme high and low values from each time history outside the range of plus or minus three standard deviations from the mean (from the 0.15% percentile value to the 99.85% percentile value). Then comes a cumulative frequency analysis that determines how many times each acceleration value occurs at each frequency. A further statistical analysis of the statistically processed data is then performed in Microsoft Excel to determine the absolute maximum and minimum, mean, and standard deviation of each time history. These values are then compared to the values in the BS EN 14363 standard to determine whether or not the wagon complies with the standard.

A large amount of time was once required to analyze the 80 different time histories when following the required five different processes. It took about 2 hours to process each of the time histories using retired nCode software, nSoftE, and Microsoft Excel for a total of about 160 hours, or four weeks. This does not include the time required to select the specific time histories involving curved or straight track since they are selected manually. Checks of the data were required at each stage of the manual process to ensure the quality of the resulting data against the required standard.

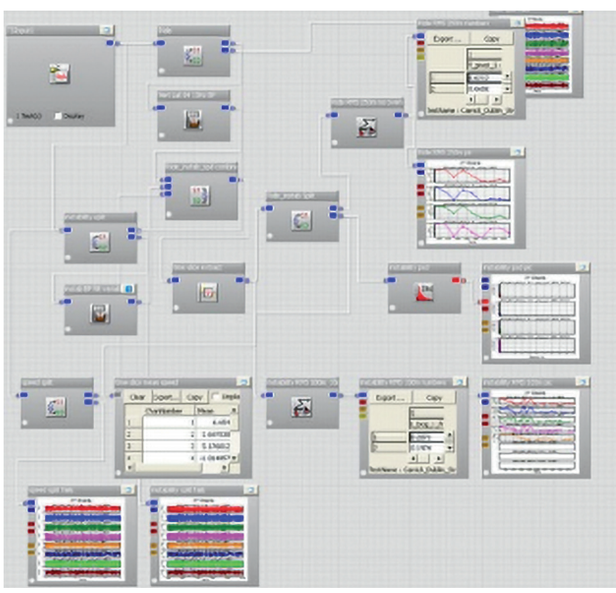
Bombardier Transportation has upgraded to GlyphWorks software as its platform to automate test data analysis because of its visual approach to logical construction of flows that eliminates the need to write code or learn a programming language.

The Bombardier Derby Test Facility undertaking a vehicle sway test on an Electrostar® train. The sway test validates computer model calculations for dynamic vehicle movements on curved track.

A close up of the No.1 end bogie showing some of the instrumentation fitted. There are accelerometers, displacement transducers and an inclinometer (for measuring tilt angle). A Doppler radar speed probe is fitted underneath.

NCODE GLYPHWORKS AUTOMATES TEST DATA ANALYSIS

Smith and Walker of Bombardier used the scripting glyph to create the five flows required to validate compliance to BS EN 14363 in response to the need to test a freight wagon modified by Irish Rail. Each flow took about four hours to construct and test, simply by dragging and dropping analysis building blocks in GlyphWorks. Time histories are selected and the engineer then simply clicks a single button and each flow, including filtering and cumulative frequency analysis, is performed automatically. The statistical results then transfer into an automated Microsoft Excel spreadsheet for further statistical analysis and reporting.



> CONSIDERING THE SCALE AND QUANTITY OF DATA ANALYSIS REQUIRED FOR THIS PROJECT, IT WOULD HAVE BEEN IMPOSSIBLE TO COMPLETE IT ON TIME AND ON BUDGET USING MANUAL TEST DATA ANALYSIS METHODS
>
> *Wendy Smith, Test Engineer for Bombardier Transportation*

GlyphWorks 'flow' Bombardier uses to analyze ride and instability characteristics specific to straight track sections. It starts with a time history input, then channel splitters, different filters for different channels, test section extraction and running statistic calculations.

ABOUT BOMBARDIER TRANSPORTATION

Bombardier Transportation offers one of the most comprehensive rail vehicle portfolios in the world, building passenger rail vehicles, locomotives, bogies and propulsion, and control systems. Bogies consist of the interface between the vehicle body and the rails. Over 100,000 Bombardier rail vehicles are in operation globally. Bombardier metro trains are providing reliable passenger service in more than 40 cities worldwide. Bombardier is the leading global supplier of rail equipment and services in 7 out of 11 product segments in which it operates. Bombardier has participated in almost every high speed train operating today in Europe. For example, Bombardier's Regina multiple unit passenger train set a new Swedish speed record or 295 kilometers per hour.

HBK – Hottinger Brüel & Kjær
www.hbkworld.com
info@hbkworld.com