**The Rushmore Drilling Index (RDI)**

Participants of the Drilling Performance Review asked Rushmore to use their global drilling database to develop an index of drilling ‘difficulty' which would allow them to...

- group and compare the drilling performance of wells of similar difficulty
- 'normalise' drilling performance across different types of wells
- 'normalise' drilling performance across different units or countries.

The Rushmore Reviews database is an ideal set of data for this analysis, as it covers a large number of countries and many different types of wells. Furthermore, because Operators submit data on all their wells, both "good" and "bad", there is a wide spread of drilling performance levels.

The development of the index was governed by the following principles:

- Rushmore would construct the index using only data from their global database.
- Rushmore would minimize subjective prior assumptions by allowing the data to dictate both the qualitative and quantitative aspects of the formulation of the index.
- Rushmore would use 'drilling speed' as a proxy for the more subjective 'drilling difficulty'.

A formula for calculating the RDI for an offshore well was derived through rigorous statistical analysis. This analysis was based on all the offshore wells drilled between 2001 and 2008 which matched the following criteria...

- They were 'new' wells (i.e. drilled from surface) over 500m in length.
- They were not multilateral wells, locator wells, swamp barge / submersible rig wells.
- They were not wells with geological or contingency geological sidetracks.
- They were not wells abandoned in order to be re-spudded.
- They had not been drilled 'under balance'.
- All the data items required for the analysis were available for each well.

A decision was made to exclude a large number of wells drilled in Thailand since their distinctive features skewed the rest of the data. Thus the final dataset used in the analysis contained over 4,700 offshore wells.

Once the method for calculating RDI values had been validated the technique was repeated using land well data. Again the analysis used all the available land wells in the Rushmore Reviews database which met the criteria, except for a large number of Venezuela wells which were omitted as they skewed the data. The dataset used in the land well analysis contained over 3,600 wells.

The analysis initially used linear regression to derive a model for predicting the number of days to drill a well. This model has formed the basis of the Rushmore Estimated Drilling Days (REDD) – a calculator which gives a P50 estimate of the time the ‘average’ Operator would take to drill a well with specific characteristics.

From the model it was possible to formulate an equation for calculating the “predicted” drilling speed. Again, based on the drilling performance of all the Operators represented in the dataset this is an estimate of the speed with which the ‘average’ Operator would drill the well. The equation takes into account the country and 10 physical characteristics of the well (8 characteristics for land wells).

Finally the predicted drilling speed of a well was converted into an index number. In the first version of the RDI (published in 2007) the index number ranged from 1 for the easiest wells to 100 for the most difficult. However, because this method capped the index numbers at 100 it meant that more difficult wells could never have a higher number. The method also did not produce "multiplicative" index. A well with an RDI of, say, 80 was more difficult to drill than one with an RDI of 40 – but it was not valid to say that it was **twice** as difficult. The index could only be used to make statements of "more" or "less" difficult.

In the second version of the RDI (version 2.0) these limitations were addressed. The RDI is now open-ended, and index numbers range from about 10, for the "easiest" wells, to over 200 for the most difficult. As more difficult wells are drilled so higher index numbers may result. At present approximately 95% of wells in the database have an RDI value of 100 or less.

Because the RDI is now more closely based on the estimated speed it is legitimate to use it multiplicatively. So, a well with an RDI of 80 is twice as difficult as one with an RDI of 40, when comparing offshore well against another offshore well, or land well against another land well.

The model is less accurate at the extremes. For this reason if the REDD value is either very large (>250 days) or very small (<4 days) we will not display it. Similarly very high RDI values (>250) will not be displayed.

Note - as the offshore RDI values and the land well RDI values are produced from different equations it is not possible to directly compare offshore RDI values against land RDI values.

Further work to refine the model resulted in version 2.1 being published on 22 December 2008. The result of this has been an average reduction in RDI value of around 10% when compared with the version 2.0 values.

Wells on the website now show the new RDI (version 2.1) values, providing they meet the original criteria. There is no intention to change these published values until a recalculation is performed to include wells drilled in 2009. No decision has been yet taken about the best way to keep the index up-to-date with new data, one option would be to publish both the ‘original’ RDI value (ver 2.1) and also the ‘current’ value.

In addition to the RDI numbers shown on the website for wells, the index number can be readily calculated for any existing or planned well where the required characteristics are known.

If you would like more details of the statistical analysis and mathematics used to derive the RDI (or the REDD) please email Peter@RushmoreReviews.com