Unconventional Resource Risk Assessment- A Perspective Emphasizing Risk Quantification & Stage-wise De-risking

Mohit C. Mathur, Robert W.R. Weight, Clay Kurison, and Mohammed Ali Mukati

Saudi Aramco, Dhahran, Saudi Arabia

Abstract

Unconventional plays are high risk to develop because of their distinctive reservoir properties. Although the first plays underwent reservoir characterization, competitive leasing practices and acreage holding requirements expedited horizontal-well developments, leading to a predominantly engineering focused de-risking approach. While this has yielded success in acreage with representative data density, others have failed because of inadequate understanding of heterogeneous subsurface properties. Thus, inviting evaluation of subsurface risk and uncertainty which impact commercial viability of unconventional plays.

The objective of this paper is to present a systematic risk assessment approach for emerging unconventional plays. Risks have been categorized into technical and commercial elements to be holistically assessed at defined stages of the play life cycle, i.e., exploration, appraisal, pilot and development. Technical risks comprise fundamental risk elements; presence, storage and deliverability; gauged by a working petroleum system with sufficient resource density and recovery/estimated ultimate recovery. Ideally, commercial risk includes economic assessment resulting in high-graded development areas. However, during early play assessment commercial risk can be evaluated using elements such as; surface/infrastructure accessibility, drilling depths and non-hydrocarbon fluids.

The risk assessment approach allows the expansion of fundamental critical risks to associated sub-elements unique to each type of asset. Risk quantification is facilitated by required evaluations of data quality/quantity, interpretation confidence levels and minimum tangible threshold values for each critical risk element to assign chance factors to sub-elements of critical risks. The presence risk helps in defining the zero edge of play segments considering the thresholds of the petroleum system elements (source, reservoir, trap and seal), confirming with the outcomes of the wells. For storage and deliverability risks, the effectiveness of reservoir parameters (thickness, porosity and saturation) and geomechanical/drainage parameters respectively, enable chance that resource densities and hydrocarbon recovery meet minimum economic thresholds. The sensitivities of technical risks are further checked with the commerciality risk to establish the chance to produce hydrocarbon commercially. This approach brings the chance of development based on product of chance of success from the four fundamental risk elements (presence, storage, deliverability and commerciality).

The risk assessment approach presented here is based on the chance of development incorporating technical and commercial risk elements together at each de-risking stage of an emerging onshore unconventional play evaluation cycle. This requires multi-disciplinary teams integrating geosciences and engineering perspectives and representative data to de-risk each stage and support decision making. This helps in addressing the impediments and prioritizing plays so that time and resources are better spent to meet strategic and economic interests.