SPE Paper Number SPE-130185-PP

Case study: Resource Play Risked Evaluation Approach for the Full Life Development of a South Texas Opportunity

Kossila Kechemir – Swift Energy Company, Peter Tyler - Enersight Corp

This paper was prepared for presentation at the SPE Hydrocarbon Economics and Evaluation Symposium held in Dallas, Texas, USA, 8–9 March 2010.

Abstract

Deriving a risked development plan for a resource play has typically involved looking at several development scenarios and well counts separately and then tying these together in some form of decision tree approach to come up with the total risked evaluation. This approach often causes problems for the infrastructure and midstream groups as they are asked to provide strategies for various reservoir options that are not easily visualized. A new approach described in this Case Study involves the use of an integrated toolset that allowed for several completely different development scenarios to be analyzed that were based on a risked evaluation of the play. The ease in which the development scenarios are combined allowed the team to quickly determine a range of possible outcomes and clearly understand the medium to long-term capital requirements of the opportunity. The visual nature of the outcome improved the decision makers' overall understanding of the development.

For this specific South Texas resource play opportunity, the extent of the formation was poorly defined and only seismic and analogy data were available to define a range of possible reservoir characteristics. Based on analogous data, several different potential reservoir production models were defined and the extent of the reservoir estimated. These assumptions were then turned into various realizable development options including their economic values.

The process and workflow of how the production options were turned into economic models is the focus of this paper. By creating a network flow diagram of the options, decision makers were able to better understand the range of possible outcomes; including the capital and infrastructure requirements of the options. This approach significantly improved the communication with the team and significantly reduced the development option preparation time. By facilitating more engaged discussions around the development options, the entire team was able to better evaluate the opportunity and the capital requirements. Although this was a relatively small opportunity (9 wells maximum), the same approach is equally applicable to the major unconventional resources being developed worldwide.

Introduction

Evaluating a resource play opportunity can be a daunting task due to the potentially large number of drilling locations and required infrastructure planning. The initial extent and the probability of finding hydrocarbons in an offsetting location often leads to multiple development options. Modeling each possible development option can be a complex task usually incorporating many different tools as well as custom developed spreadsheet solutions. Creating a comprehensive economic development plan that can be used to evaluate how the project will interact with the rest of a company's portfolio is especially difficult and time consuming. This step is often neglected in a short timeframe acquisition opportunity, as it requires evaluating the entire prospect up front.

In this South Texas project, the team needed to evaluate the opportunity to acquire offsetting acreage to existing production. Based on available technical data, it appeared that the formation was less prolific in the region and the team was unsure of the specific geologic properties. Based on analogy evaluations, three distinct development scenarios were derived each based on a different permeability assumption. The challenge was how to evaluate the full life potential of the project and define it in such a way that its potential impact on the overall portfolio could be evaluated, including the impact of future capital requirements.

The team found a solution to the problem by developing a single evaluation that included three distinct development options, and the possibility of a dry hole. The development options were displayed within the structure of a decision-uncertainty tree and the probabilities of each occurrence incorporated into the structure as shown in **Figure 1**. The drilling timing and rig requirements were also incorporated in order to evaluate its impact on the portfolio and operations.

This new approach significantly improved the team's ability to describe the opportunity to management in such a way that an informed decision on the opportunity could be made. The approach allowed management to visualize easily the impact of the specific development outcomes on capital requirements.

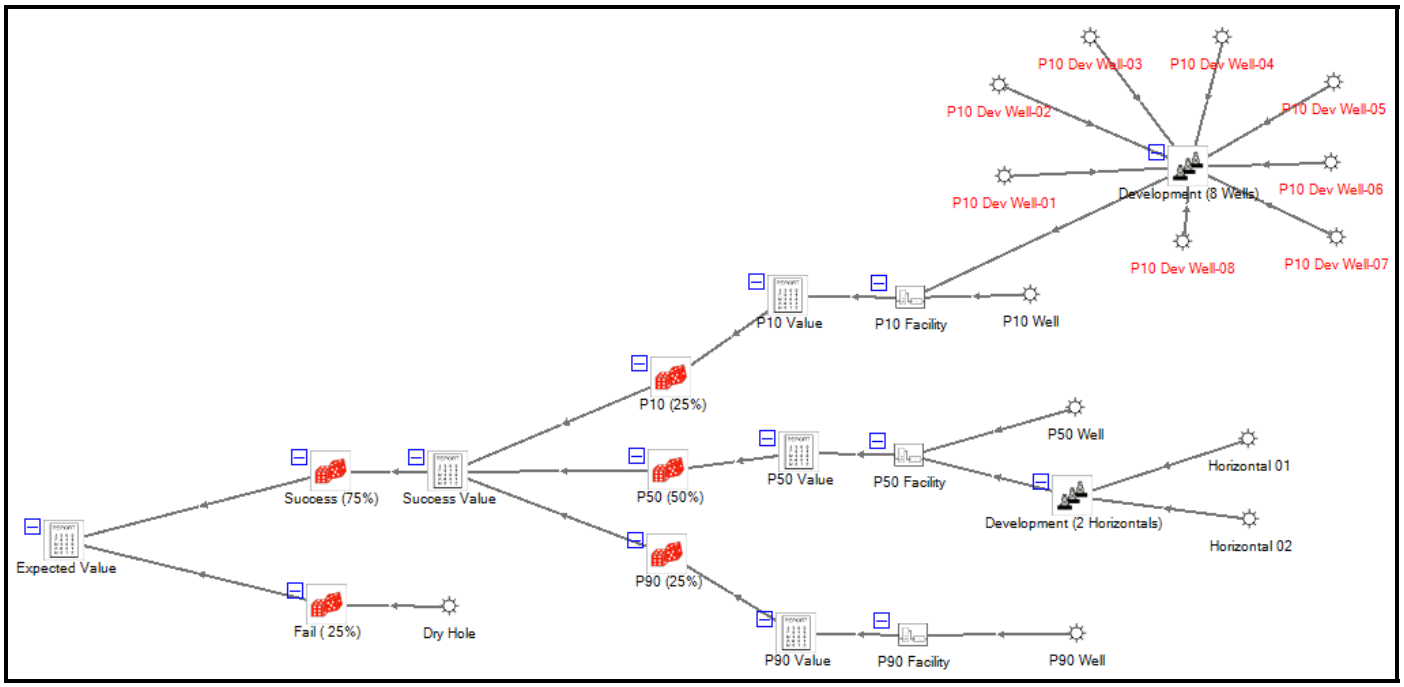


Figure 1 Development Options in Uncertainty Tree

Evaluation Process

The prospect being evaluated was an offset from an existing field and a statistically significant analogous data set was developed based on prior experience in the formation. The estimated recovery of the initial well was derived using a statistical evaluation of analogous wells in the region. The result of the analog evaluation was used as the basis for the risked development plan. Three distinct initial well results were used as the basis of the three distinct development options modeled. Each option was fully evaluated including drilling, facility and infrastructure requirements. The three options are defined in detail in the following sections. By combining the three distinct possible development outcomes in a single visual evaluation, decision makers were able to easily understand the potential outcomes of the project and the probability of each outcome occurring.

The P90 initial well profile represented very poor financial returns and no further drilling would be pursued. If the well came in around the P50, then further horizontal drilling would be required to economically and technically extract the volumes in a low permeability environment. The P10 profile represented significantly better permeability, and in that case, vertical wells would be drilled to maximize financial return on the asset.

Recovery and Production

The reserves for the type well were based on the statistical recovery from 500 selected analogous wells in the region **Figure 2**. The P90 recovery is 200 MMCFE, the P50 recovery is 545 MMCFE and the P10 recovery is 850 MMCFE. These figures include all forecasted recovery including re-fracs. From close proximity wells it was concluded that there would be very little condensate produced from wells on the targeted acreage. Therefore, the only liquid production expected is NGLs.

Results - Statistical Summary of Analogs		
Well EUR (MMCFE)	Analog Data Set	Lognormal Model
P90	200	205
P50	545	520
Pmean	600	605
P10	850	1000
P10/P90 ratio	5	6

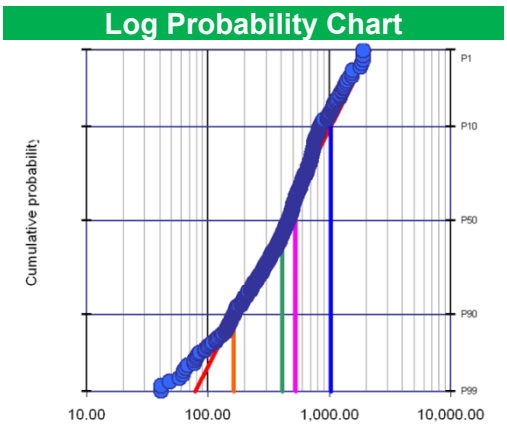


Figure 2 - Field Reserve Distribution

Based on the most recent analogous wells, initial rates over 1 mmcfpd have appeared to become the norm. Economics for the type well have been run at an initial rate of 1,405 mcfpd for the P10 case and 400 mcfpd for the P90 case. For the P50 vertical well, an initial rate of 1,000 mcfpd was used and 10,000 mmcfpd for each of the horizontal wells.

The geologic risk elements were reviewed for the initial well location and a combined probability of geological success of 75% was derived.

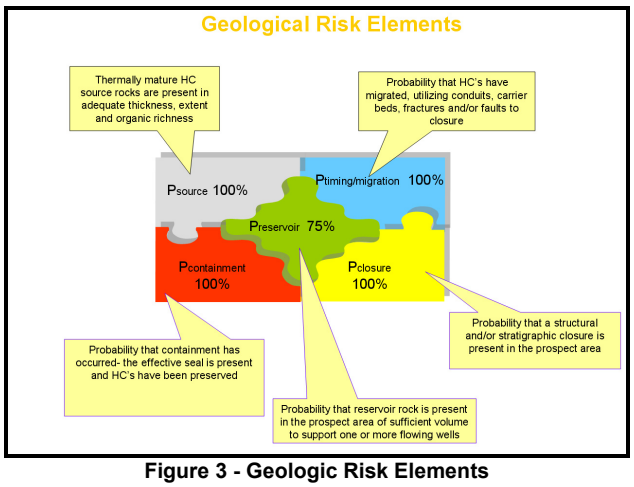


Figure 3 - Geologic Risk Elements

Initial Well Outcomes

Based on the statistical analysis, 3 distinct well outcomes were derived (P10, P50, P90). Each had the same drilling and completion costs. Description of the well and its outcomes are included in the **Table 1.**

Ps	75%
Drilling Cost	1,000 m$
Drill time	15 days
Completion Cost	800 m$
Completion Time	5 days
Dry Hole Costs	1,025 m$
Recomplete Cost	200 m$

	P90	**P50**	**P10**
Initial Rate (30 day)	400	1000	1405
EUR	200	545	850

Table 1 – Initial Well Description

The dry hole and abandonment cost is estimated at 1,025M$. In the success case, three scenarios (P10, P50 and the P90) were devised by the team based on the best knowledge of how the various reservoir outcomes would be developed.

The probability of occurrence for the P50 case is 50% and the probability of occurrence is 25% each for the remaining cases (P10 and P90) as shown in **Figure** 4.

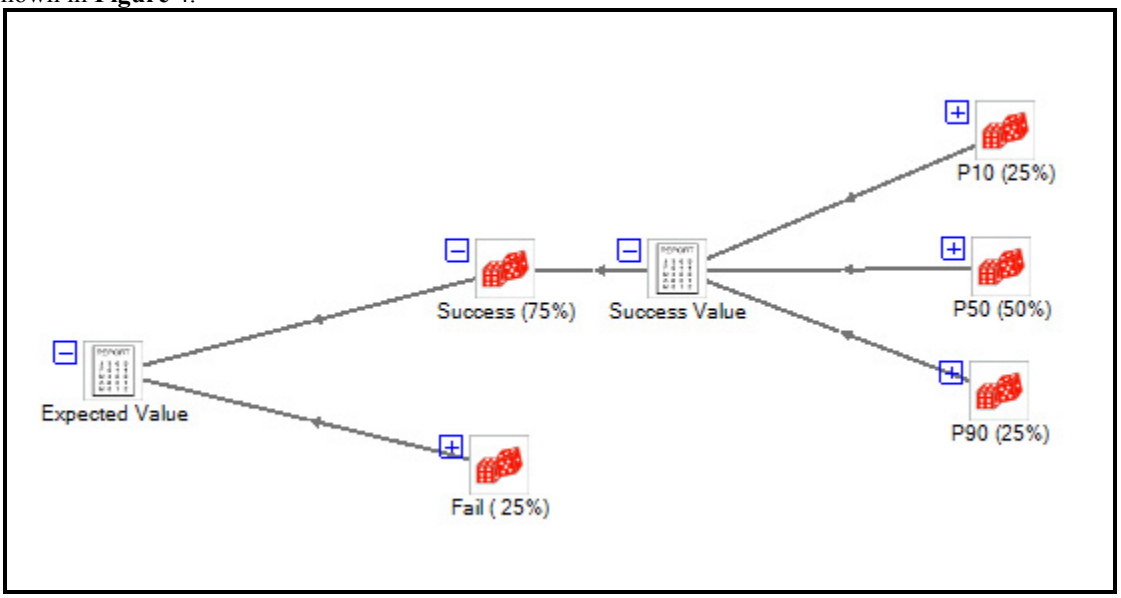


Figure 4 - Probability of Outcome Occurrence

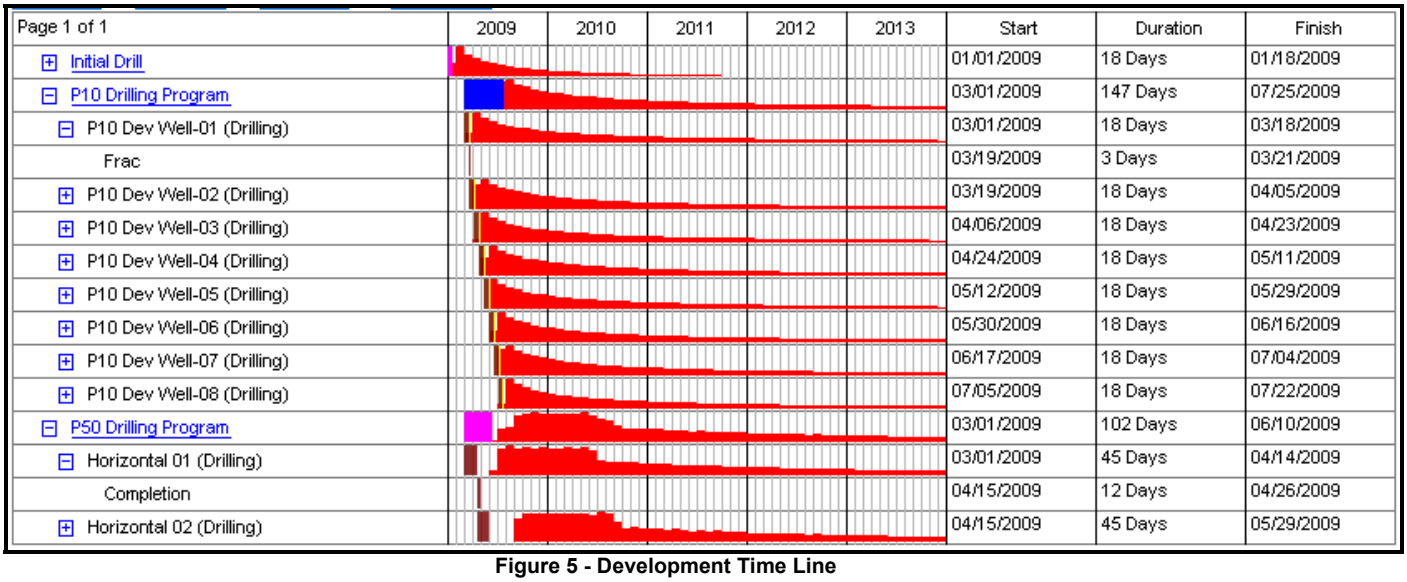
Defining Distinct Development Timelines

The next step was to look at the development timeline and expected development options. Each option was detailed, and the following risked development plan created. By taking advantage of an integrated planning, risk and economics environment, three distinct development options were constructed within a single visual decision tree. Each outcome represented the team's evaluation of what the development requirements would be based on the initial well outcome. The three outcomes are based on the P10, P50 and P90 reserves outcomes of our initial well. The assumptions used to create each of the outcomes are described in **Table 2.**

Table 2 - Distinct Development Options

	P10	P50	P90
Probability of Occurrence	25%	50%	25%
Number of Wells	No additional	2 horizontal	8 vertical
Number of Drilling Rigs	0	1	1
Drilling Time (days)		45	18
Completion Time (days)		12	3
Facility Timing		To be complete at same time as drilling initial well	After each second additional well
Facility Cost (M$)	125	350	220 x 4

The development timeline for the project and its alternative development scenarios are shown in **Figure 5**. By incorporating the entire development plan into the evaluation, the rig availability requirements and the facility timing were available for review. The integrated plan including facility, drilling and completion requirements ensures that any modifications of one element immediately impact the schedule of the other. This direct association eliminates the possibility of the drilling being deferred and associated facilities timing remaining unaltered, or vice versa. Either of these situations will usually have a negative impact on the overall financial outcome of the project. The predicted value of the entire project is only realized if the development occurs as described in the evaluation. Deferral in the drilling or infrastructure aspects of a project will influence the overall value measures including NPV, PIR and ROR of the project.



Page 1 of 1	2009	2010	2011	2012	2013	Start	Duration	Finish
Initial Drill						01/01/2009	18 Days	01/18/2009
P10 Drilling Program						03/01/2009	147 Days	07/25/2009
P10 Dev Well-01 (Drilling)						03/01/2009	18 Days	03/18/2009
Frac						03/19/2009	3 Days	03/21/2009
P10 Dev Well-02 (Drilling)						03/19/2009	18 Days	04/05/2009
P10 Dev Well-03 (Drilling)						04/06/2009	18 Days	04/23/2009
P10 Dev Well-04 (Drilling)						04/24/2009	18 Days	05/11/2009
P10 Dev Well-05 (Drilling)						05/12/2009	18 Days	05/29/2009
P10 Dev Well-06 (Drilling)						05/30/2009	18 Days	06/16/2009
P10 Dev Well-07 (Drilling)						06/17/2009	18 Days	07/04/2009
P10 Dev Well-08 (Drilling)						07/05/2009	18 Days	07/22/2009
P50 Drilling Program						03/01/2009	102 Days	06/10/2009
Horizontal 01 (Drilling)						03/01/2009	45 Days	04/14/2009
Completion						04/15/2009	12 Days	04/26/2009
Horizontal 02 (Drilling)						04/15/2009	45 Days	05/29/2009

Figure 5 - Development Time Line

Success P90 Project Definition

Reserves for P90 node are 200 MMCFE and the drilling costs were estimated at 1,000 M$ and initial completion cost at 800 M$ as shown in **Table 1**. A refracture was forecast and estimated to cost 200 M$. The facilities costs was estimated at 125 M$. In **Figure 6.** The production profile used is displayed. In this low production case, the initial investment is not expected to be recovered, however the facilities costs are justified on a forward value evaluation of the project, and this is not the expected, but rather a worst-case successful outcome.

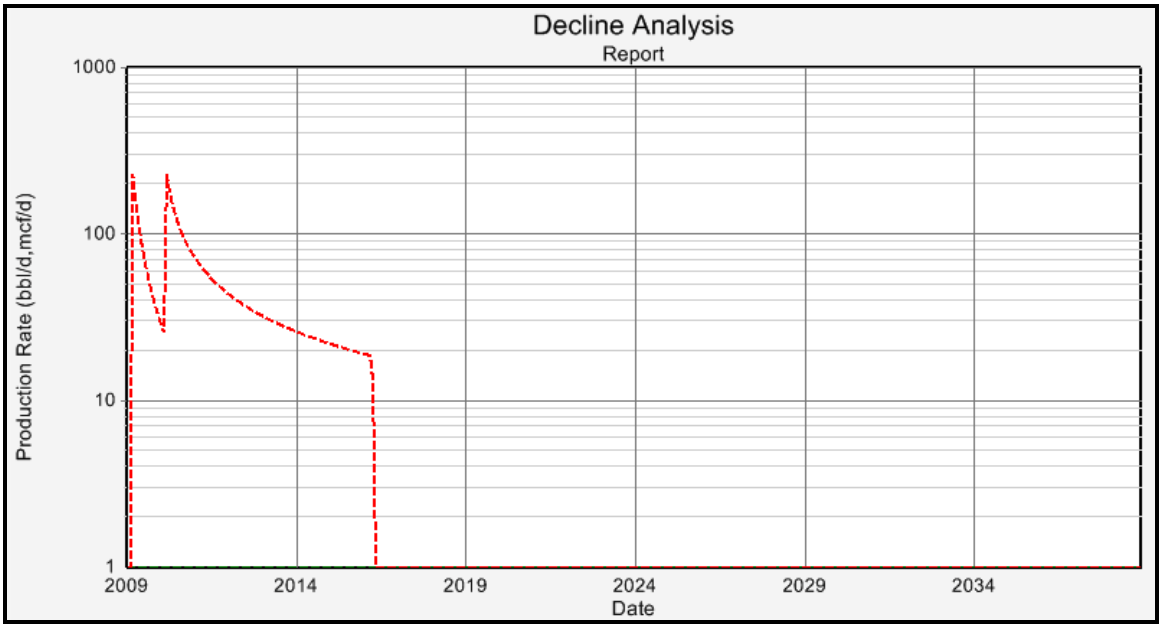


Figure 6 - P90 Production Forecast with Refrac

Success P50 Project Definition

The P50 statistical recovery from the probabilistic analog run for the wells is 545 MMCFE and this value was used to construct the P50 case. The drilling and completion cost is estimated at 1,800 M$ for the initial well.

If the P50 reserves (510 MMCF) are found, the area will be developed with 2 horizontal wells as shown in **Figure 7**. A drilling time of 45 days and 12 day completion time was assumed for the wells at a cost of 7,250 M$, and a single rig would be used. The facilities cost is estimated at 350 M$.

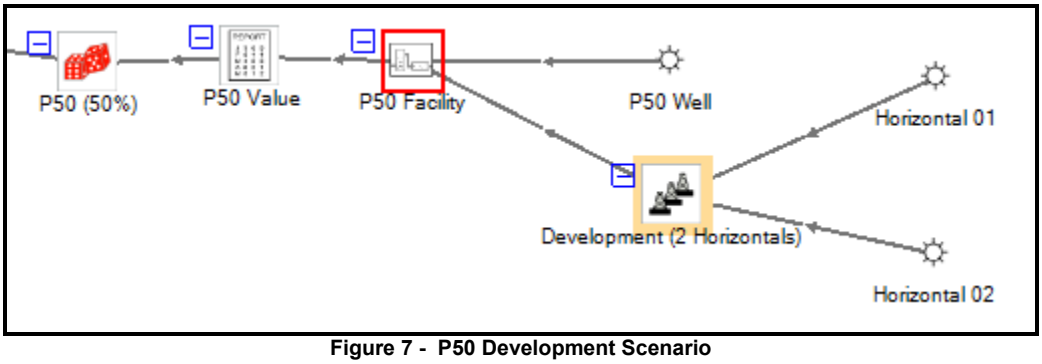


Figure 7 - P50 Development Scenario

Success P10 Project Definition

The P10 scenario assumes an area of relatively high permeability and drainage radius is found. In this case, the area can be developed with eight verticals wells as shown in the top path of **Figure 8.**

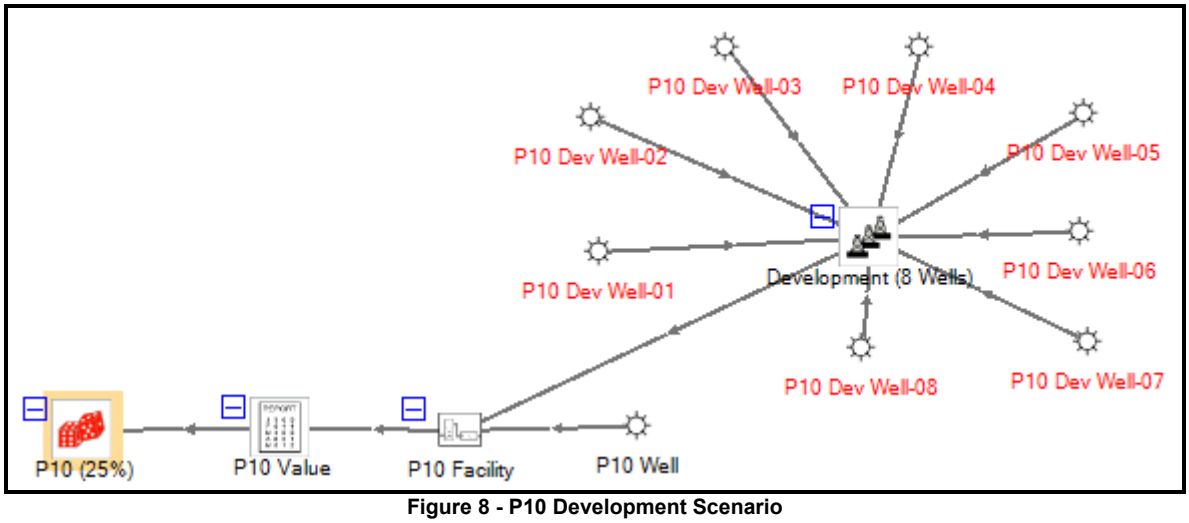


Figure 8 - P10 Development Scenario

The initial P10 well is used as the type well for future drilling. A single drilling rig was assumed to be used and a drilling time of 14 days and a completion time of 3 days were assumed for each well. Following a successful initial well, the follow-up wells assumed a 95% probability of success, independent of one another.

The assumed costs for the development wells are 1,500 M$. The facilities cost are estimated at 880 M$ for all nine vertical wells.

Expected Value Outcome

The expected value of the entire project was visualized within the tree environment, and is shown in **Figure 9**. This view, coupled with the detailed economic reports and the Gantt chart were used to provide management with the information needed to make informed decisions.

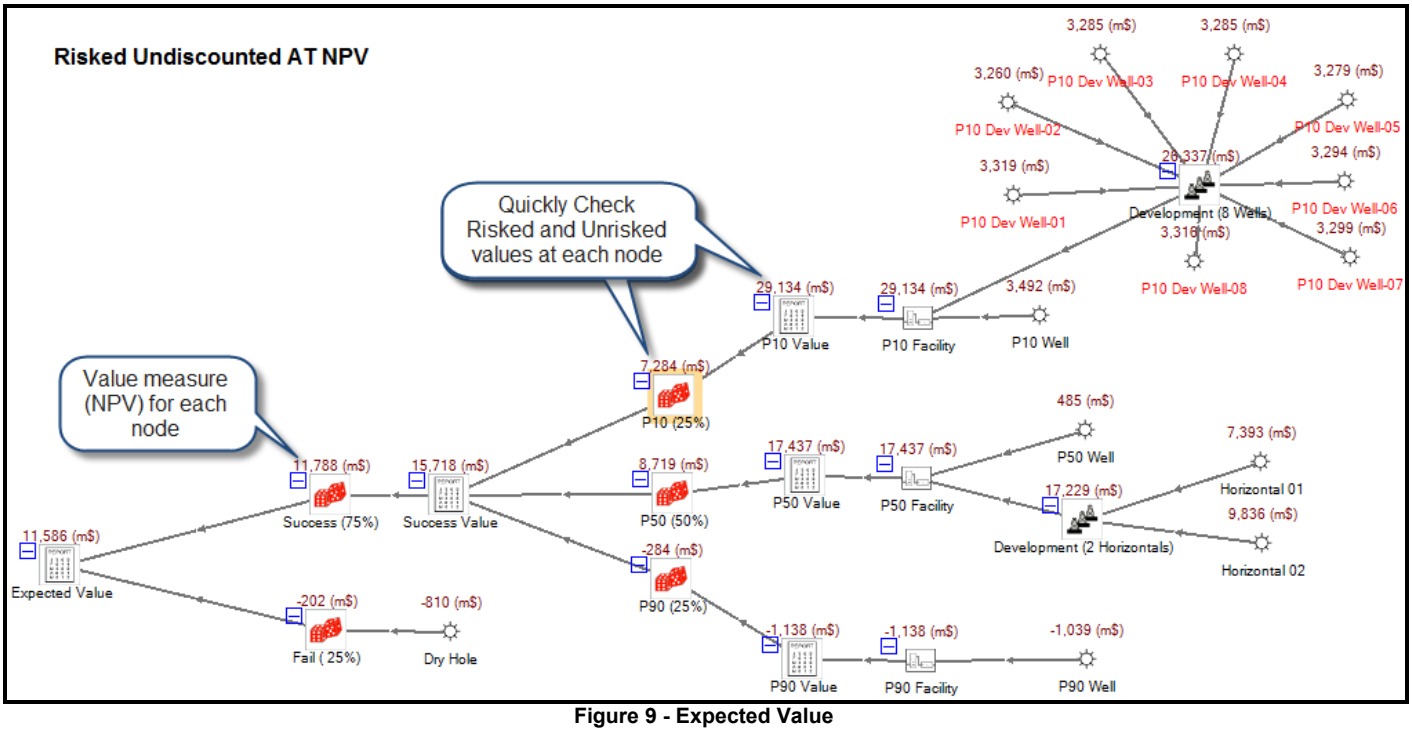


Figure 9 - Expected Value

The multiple value measures used during the evaluation are summarized by outcome in **Table 3**. The P90 success value was negative, due to the initial drilling costs; however the completion and connection costs were justified on a point forward basis.

(Net Values)	Expected Project	Expected Success	P10	P50	P90	Fail
Reserves (mmcf)	3,175	4,233	6,783	5,005	139	0
Capital (m$)	9,591	12,446	14,210	16,700	2,175	1,025
AT NPV (m$)	11,586	15,718	29,134	17,437	-1,138	-810
AT NPV @10% (m$)	6,118	8,535	16,453	9,493	-1,299	-853
AT PIR @10%	0.66	0.70	1.20	0.58	-0.61	-
AT ROR (%)	42.4	44.9	77.9	38.9	-	-

Table 3 – Expected Value Results by Node

Conclusions

The visual nature of this uncertainty based development approach significantly improved understanding of the opportunity. The integrated development tools allowed for more detailed and improved scheduling of the development plan, while reducing the overall time to complete the evaluation. The ability to see the specific development options, and their likelihood, in conjunction with the initial costs and overall project costs is seen as a significant benefit of the new approach.

The other area where significant gains have been made is in the interactions between the teams due to the integrated and visual aspects of the project model. This enhanced communication improved the confidence and comfort of the estimates, while simultaneously reducing the cycle time.

This full cycle evaluation allowed the asset to be quickly incorporated into the portfolio, and its impact on key planning metrics evaluated in the sense of the entire opportunity instead of just a single well opportunity.

Acknowledgements

The Authors would like to thank Swift Energy Company for supporting this project and allowing the release of their information.

References

Dubois, J.R. 2004. Portfolio Management Using Questionable Quality Data. Paper SPE 90395 presented at the SPE Annual Technical Conference and Exhibition, Houston, TX. 26–29 September

Newendorp, P.D.1996: Decision Analysis for Petroleum Exploration. Aurora, Colorado, USA: Planning Press,