SENSITIVITY ANALYSIS

info@aptaconsultingltd.com www.aptaconsultingltd.com

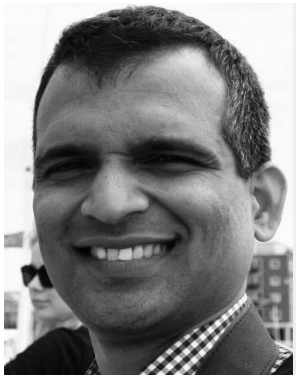
ABOUT APTA CONSULTING

APTA provides Financial modelling, Petroleum Economics evaluation & analysis, and Excel training for business modelling and data analysis to range of clients. Our clients range from blue chip to small enterprises and individuals. Our clients have access to high quality, cost effective modelling support delivered by team of experts around the world.

APTA OIL & GAS TEAM

APTA's dedicated Oil & Gas modeling team is led by Santosh Singh. Santosh has more than 12 years of industry experience. With a technical background in drilling engineering and further qualification in Finance and Economics, he has worked in a number of major technical and commercial functions and gained extensive experience in economics evaluation, business development and commercial agreements.

Santosh's commercial valuation and analysis experience covers Africa, Asia, and Eurasia to name a few. He has a proven ability in the fiscal regime modelling, investment analysis, and providing high quality support to management for the strategic investment decisions.

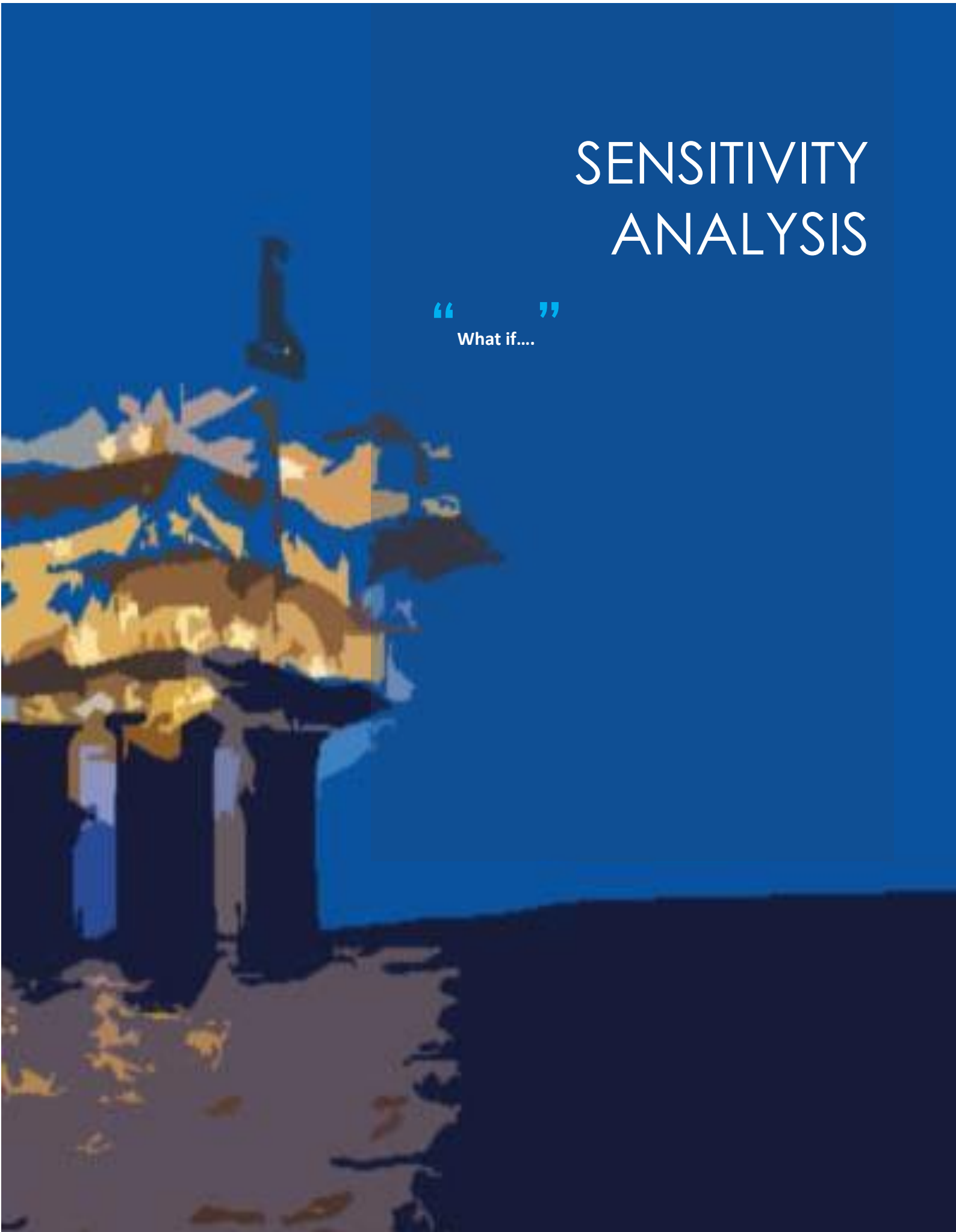


SANTOSH SINGH
PRINCIPAL CONSULTANT, OIL & GAS

SENSITIVITY ANALYSIS

“ ”

What if….



SENSITIVITY ANALYSIS

Cash flow analysis of an upstream project requires inputs from various sources. Some of the data comes from technical department such as reservoir engineering, G&G, and planning team. These data are mostly field costs and production profile related. Some data comes from legal and commercial teams such as fiscal contracts, partner's equity and working interests, carry structure etc. Some other inputs such as price, inflation, exchange rate, discount rate etc. is provided by the corporate finance team.

These technical, fiscal and economic data are not 100% certain. There is always the chance that some of them may not be same at the time of actual implementation of the project. They are at best the best case assumptions. For example the price may be drastically different than the one used for estimating the NPV at a given point or the cost may have changed due to cost overruns or unanticipated escalation in costs. The reserve may not perform as well as initially thought of. Or the well may turn out to be more productive than forecasted. Due to all these uncertainties, the anticipated results and the reality may be miles apart.

Sensitivity Analysis is a process by which we can test the impact of variations in the input on the final output by changing various inputs one at a time. This helps us know the robustness of the project. It also gives us insight as to which of the inputs the project economics is more sensitive to. It helps us compare two different variables that can be traded-off.

For example, we can answer question such "How much incremental investment is required to enhance the production by X barrels?" or "Is it worth spending more in Capex if we can cut Opex by X %?", or "What happens to the project NPV if cost goes up by X % or X $?"

The impact of varying just one single input variable (such as price, Opex, Capex, etc.) at a time gives a clearer indication of the impact of each variable on the selected output economic indicator such as NPV, IRR, NCF etc. We can assess the impact of higher or lower Capex, higher or lower price, higher or lower production, tax rates etc.

Varying just one input variable at a time may not be realistic as in real life several inputs work in tandem and seldom do they vary in isolation (for example, if the Oil price crashes, it also influences the Capex and Opex). But by varying these inputs one at a time helps us isolate the effect of these inputs on the outs easily. These inputs can then be scrutinized in more detail. Say for e.g. a project NPV is highly sensitive to a delay in

first Oil, then we should be looking at ways and means of accelerating the project and what it takes to accelerate the project in terms of costs and resources.

Typical parameters which may be varied in the sensitivity analysis are:

- ✓ Capex
- ✓ Opex (fixed and/or variable)
- ✓ Production
- ✓ Project delay leading to delay in first production
- ✓ Tax rates
- ✓ Profit Oil splits and Cost Oil limit
- ✓ Discount rate
- ✓ Crude price
- ✓ Inflation and escalation

Fiscal terms that are negotiable can be sensitizes and cases run to see their impact on specific indicator of interest such as NPV, IRR etc. This would generally be done in order to bid or negotiate for a new license.

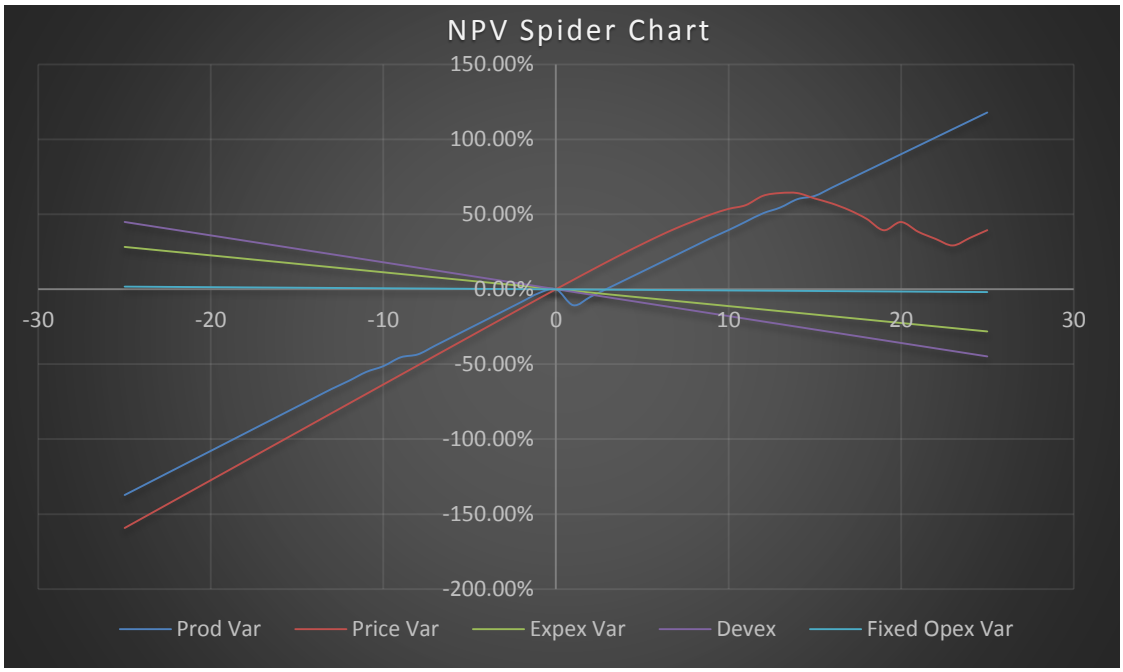
In the sensitivity analysis what we are looking at is basically the change in the target value with respect to the original or base value. First we run a case, keeping the standard inputs and we call it base case. Next we change the specific variable and note down the change in the value of target variable (economic indicator such as NPV, IRR etc.). The output of the sensitivity analysis can be shown both in a grid form and in chart and graphs form.

SPIDER DIAGRAM

One of the most widely used graph in the industry is called the *Spider Diagram.* A useful graphical representation is a plot of the change in NPV against the percentage change in the parameter being varied. Because of the shape of the chart, its name is Spider Diagram.

On the Y axis of the Spider Diagram is usually NPV. The X axis represents variation in inputs. The origin represents the base NPV with the base inputs. In the figure above, for e.g. when we increase the price or production, the NPV increases (the red and the Blue line is having a positive slope, meaning NPV is positively related to price and production change).

Spider diagram is particularly useful in optimizing a project. If we draw a horizontal line on the Spider Diagram, we can easily find the equivalence between different percentage changes of different inputs. For e.g. a 10% Capex increase may have the same decrease in NPV which a 10% increase in Opex will bring.



The Spider plot can visually show us to which input variable NPV is most sensitive. It's the variable with the highest slop on the diagram. Thus we can rank input variables in order of their relative influence on the indicator/value of the project.

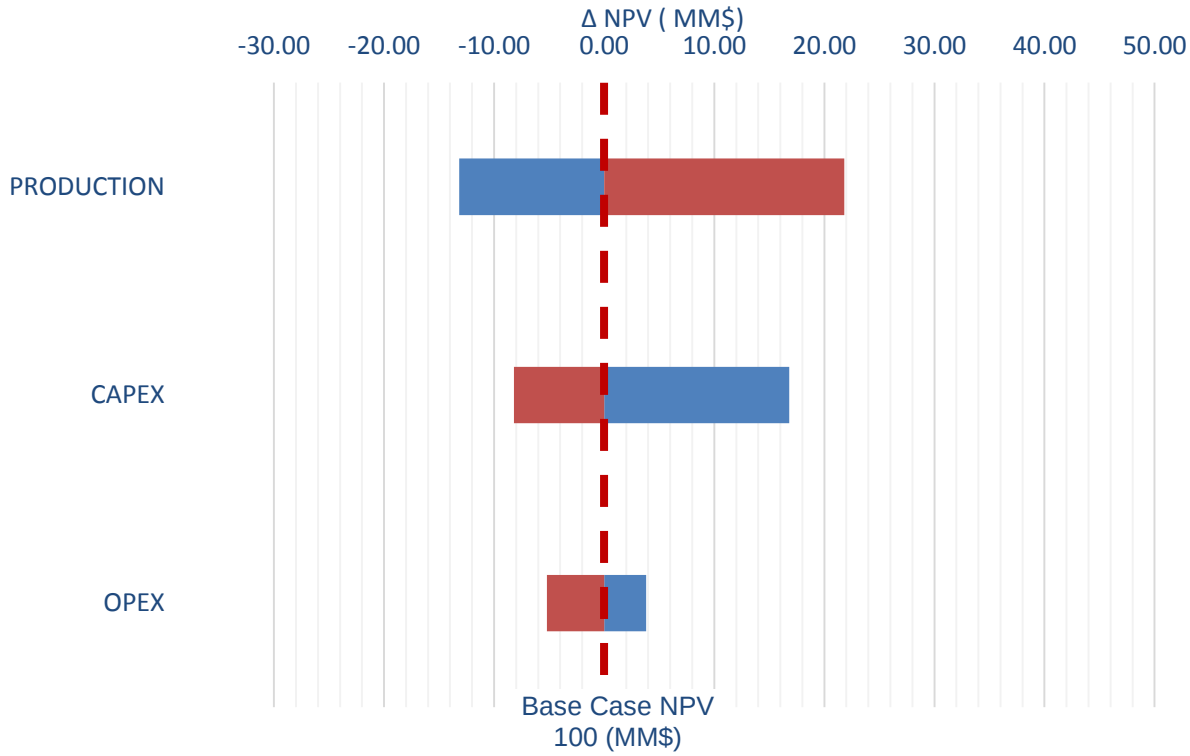
The Spider diagram can easily provide insight into trade-offs in variables. For example, it can be seen that compared to the base the equivalent reduction of NPV is brought about by either X% increase in Capex or Y % increase in the fixed Opex. We can draw an important conclusion form here that Capex could be increased X % if it leads to a Y % reduction in fixed Opex. Or we can conclude by looking at the plot that we could afford to invest X % more Capex if we can increase the reserve by Y %.

We need to be cautious while making conclusion like above from the results of sensitivity analysis as we are ignoring the interdependencies of inputs variable among each other and the out variable.

TORNADO CHARTS

In addition to the Spider Diagram, there is another chart that is equally used by economist and planners alike. It's called *Tornado chart.* A sample Tornado Chart is shown below. Unlike Spider chart, a Tornado chart shows the variance in the output indicator for a given % change in the input values, and not for all % change in the input values.

For example, the Tornado chart below is showing the change in NPV for a +/- 10% change in the different categories of the inputs. The dark Red bar represents the change in NPV if the variable increases by 10%. The Blue bar represents the change in the NPV if the input variable decreases by 10%. The Red line is the base NPV.



In contrast to sensitivity analysis, *Scenario Analysis* involves creating multiple cases each representing scenario. In a scenario we can vary not just one variable but multiple variables at the same time and create sets of inputs which are based on different assumptions related to production and cost as well as price and fiscal inputs.

For e.g. we can have three different scenarios, a “Mid” case, a “Low” case and a “High” case. In the “Mid” case we may have an optimistic production profile, and its associated optimistic cost profile. In the “Low” case we may have a lower production rate, combined with higher costs. A “High” case may have a higher production rate and a lower cost profile. In essence a scenario is culmination of multiple sensitive inbuilt into one single case.

The purpose all these analysis is to make sure that the company manages its portfolio of assets strategically so that the company sails through unfavorable scenario and benefits in the most favorable scenario.

STOP/GO ECONOMICS

Sometime only key variables that drive the value of a project are sensitized to find out their impact on the project economics. Generally, there are two key drivers to value, Oil price and reserve size. To find out the minimum Oil price and minimum field size for a given fiscal contract stop/go economics is run. This tells us the lowest Oil price for which the project will still be profitable. Similarly, the lowest field size (threshold field size) tells us the minimum reserve size for which the project can be given a go ahead for development.