PPSDM Jakarta, November 3rd, 2017

Company decision-making for geothermal projects

(GEOCAP course 1.07)

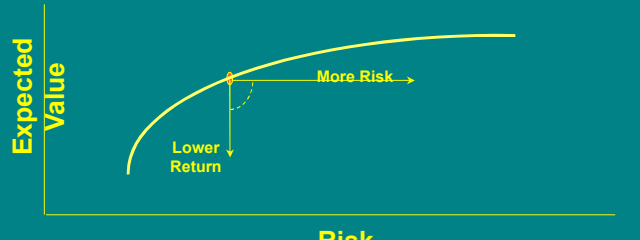
Topic: portfolio analysis, MCA, MSA, VOI, VOF

Lecturer - Ir. Christian Bos

Public document (GEOCAP-2016-REP-TNO-1.07-xx)

"Efficient Frontier"

- In Reward vs. Risk graph, the Efficient Frontier is the locus of all possible combinations of projects for which, at the constraints used:
  - **No lower risk can be obtained without loss of value**
  - **No greater value can be obtained without increased risk**



MCA – Multi-Criteria Analysis

- Decision-making is about optimizing the '*value*' of an asset, or otherwise optimizing the '*performance*' of the company, by selecting the '*optimal*' decision alternative from a range of alternatives.
- But what is '*value*'; '*performance*', '*optimal*'?
- There are many KPIs, at the different decision '*levels*'. And there are non-quantifiable issues.
- General objective function:

$$OPT\{KPI_1 \mid KPI_2 <> x; KPI_3 <> y; \ldots; KPI_n <> z\}$$

  - OPT = MAX or MIN function, "|" sign means "conditional on", and "<>" means larger or smaller than some constraint-value.
  - Example:

$$MAX\{EMV \mid IRR > 15\%; PoT < 5\ yrs; PF\ closer\ to\ EF\}$$

- Theoretically, multi-KPIs can be combined into one weighted function. But not recommended.
- Including non-quantitative KPIs: discuss.

MSA – Multi-Stakeholder Analysis

- Understanding how to make a MS-project fly
  - If one limits "stakeholder" to (co-)investors in one or more parts of the value chain,
- Different stakeholders may have different:
  - Different objective functions when making decisions
  - Perceptions of Risk, hence different IRR hurdle rate
  - Capitalization, hence WACC discount rate
  - Different portfolio effects of the project being considered
  - Different ways of obtaining security, e.g. concluding contracts with other stakeholders in the value chain
- In joint projects or in value chains, all stakeholders need to have an acceptable risk/reward ratio, i.e. a 'business case".
- MSA: tuning certain variables such that *all* stakeholders obtain a business case, taking into account their different perspectives

VoI – Value of Information

- Understanding when to propose new data acquisition
- Given a decision framework (decision tree), the Value of new Information can be computed
  - See example Slide (est. value of exploration license)
- New data acquisition costs money, and delays project (time to first production / COD)
- Hence, there should be a method how to quantify the VoI
- Information only has a value, if it has the potential to change your course of action (e.g. improved scoping, design). That potential must be made explicit.

VoF - Value of Flexibility

- All outcomes are uncertain.
- Only gradually will the truth be revealed, i.e. after having committed capital.
  - New wells, new data, production facility capex etc.
- If this info would have been known beforehand, the design might have been adapted.
- One may anticipate on this new info being revealed in time and incorporate that in the design of the facilities / wells.
- A method is required to know when to propose flexibility-options in an engineering design: VoF (as part of DTA).

MPT – Modern Portfolio Theory

- Better understanding the nature of risk and how the portfolio of projects determines how to assess individual project risk.
- Projects influence each other:
  - Summing the statistical outcome distributions of different projects influences the statistics of the population of projects
  - *(Example of summing MWe distributions of different GT-wells)*

Robustness of a decision

- **Definition of robustness / resilience: concept to be used when recommending a decision.**
- **Given a range of (probabilistic) forecasts of the performance of your asset, "robustness" means to have *adequate flexibility options* during the asset's life time such that the asset can be steered mid-course to**
  - **1) continue to satisfy a given set of KPI-constraints within certain probability limits (*downside mgt*),**
  - **2) to further optimize the selected optimization-KPI (*upside management*).**
- **Example: given your framing and probabilistic forecast of NPV and IRR within this frame, to design those flexibility options that, when striking them at the appropriate timing, e.g. per "undesired" Monte Carlo time-series realization, will bring back the ex-ante NPV and IRR distributions (pdf's) to within a predefined range. So, we have to think in terms of dynamic options, and creating these options out of the uncertainty of the predicted range of the asset's performance.**
- **A set of undesired MC realizations is to be shown + how timely striking built-in flexibility options can steer de NPV and IRR pdf's back to within some pre-defined constraints.**