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Embedding Real Options in Scenario Planning: A New Methodological Approach

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Resarch Aim

This paper aims to bridge the gap in the integration of scenarios and real options by:

1. Developing an intuitive approach to real option evaluation;
2. Combining it with scenario planning;
3. Testing the new model on **a real capital investment decision.**

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Integrating scenarios and real options: rationale

- Real options involve the application of financial options theory to investment decisions on real assets (McGrath *et al.*, 2004; Tong and Reuer, 2007)
- Real option theory emphasizes that many initial investments create relevant opportunities for follow-on investments (Dixit and Pindyck, 1994; Trigeorgis, 1996; Krychowski and Quelin, 2010).
- Real options might help decision makers to better understand the impact of the alternative patterns of evolution of key drivers of changes
- Real options are likely to quantify the financial implications for the organization of scenarios, by providing tangible and reliable measures in terms of cash flows and profits

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Integrating scenarios and real options: key issues

- No evidence is provided as how to bridge the gap between the qualitative approach of scenarios and the quantitative approach of real options (Miller and Waller, 2003; Ram and Montibeller, 2013)
- Decision makers do not have the mathematical skills necessary to use these models comfortably and knowledgeably (Borison, 2005; Triantis, 2005)

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$$

- The key issue of ***volatility***: the estimate of variance of returns is the Achilles heel of the Black & Scholes' model.

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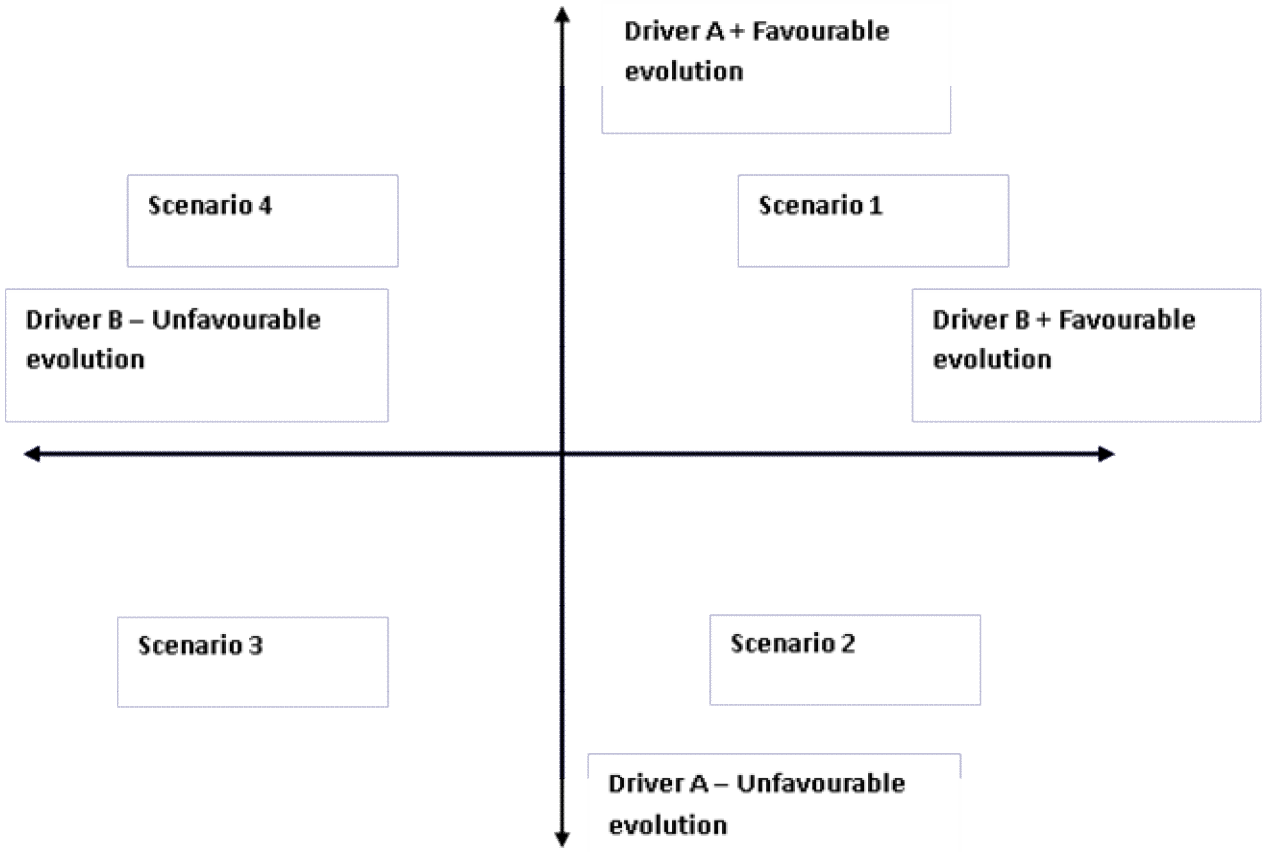
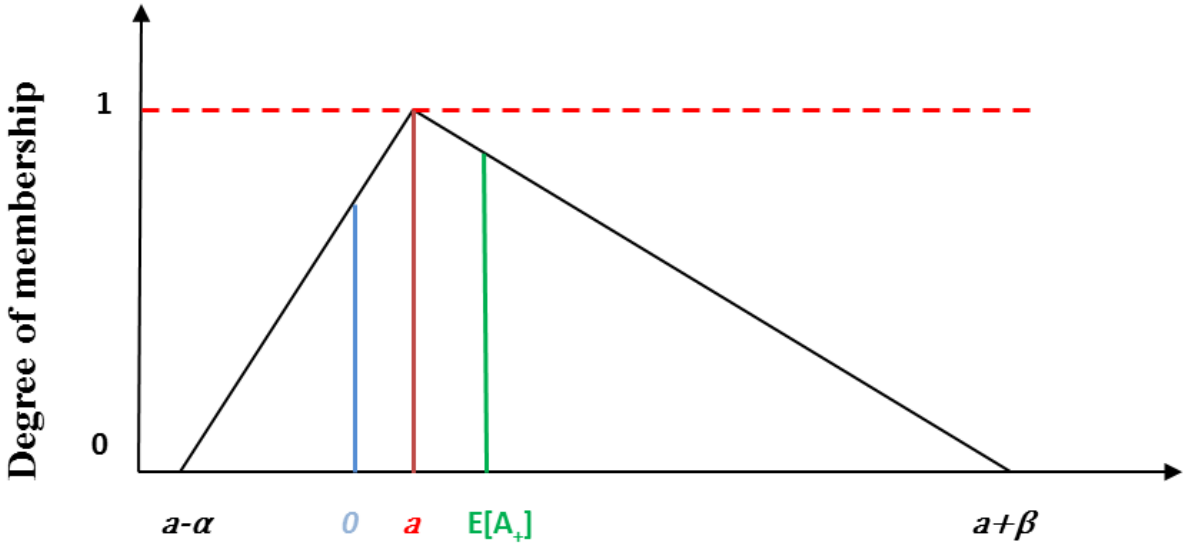
Components of the model: classical 2x2 matrix



Real options: the pay-off method
(Collan et al., 2009)



- **"worst" case scenario** (Driver A: -; Driver B: -)
- **"best" case scenario** (Driver A: +, Driver B: +)
- "**base" scenario** (combining the ' + - ' and ' - + ' scenarios)

INVEST IF PAY-OFF VALUE > REQUIRED CAPITAL

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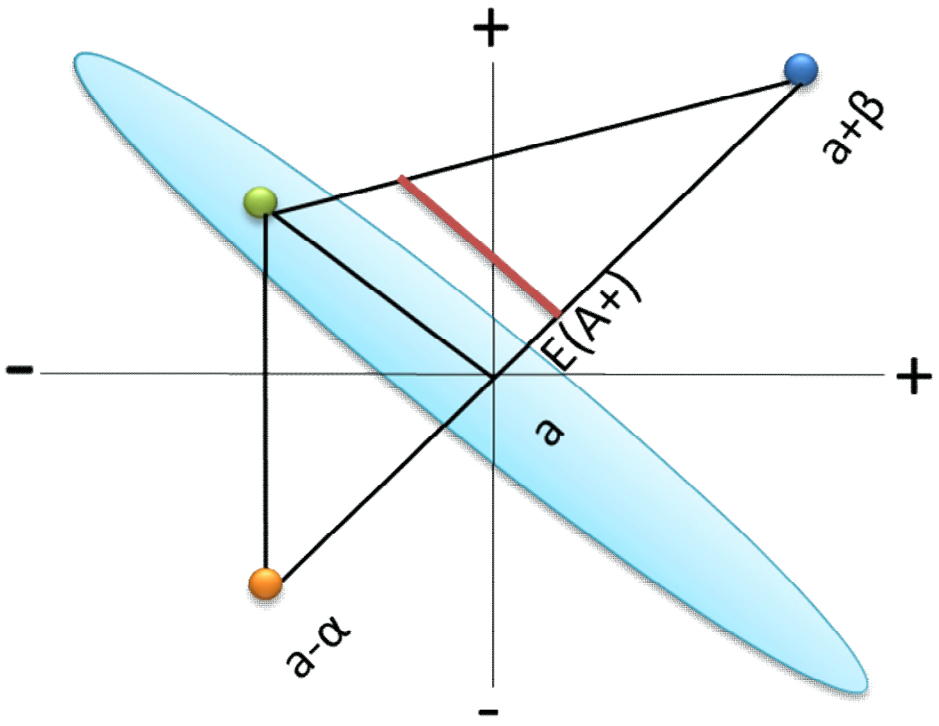
Intuitive visualisation of our model



Legend:

a	probabilised value of base case
α	difference of absolute values of base and worst case
β	difference of absolute values of best and base case
(a+β)	value of best case
(a-α)	value of worst case
1	highest possibility
0	lowest possibility
E(A+)	Pay-off Value

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Research Methodology

- Action research
- One of the authors was directly involved in the application of the method as he served as advisor to the Board of IDEa at the time of a **critical investment decision for the clinical development of a new drug**
- This privileged viewpoint allowed us to get access to primary data and to provide a detailed description of the application of the method and its outcomes

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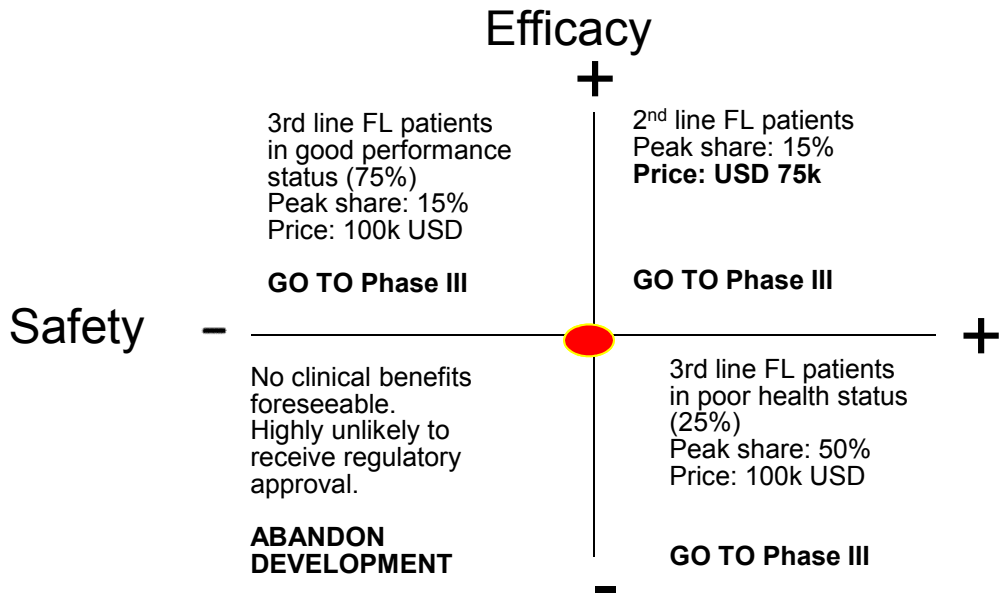
A real investment decision: IDEa-001

- A Biotech Firm is developing a novel treatment for Follicular Lymphoma: IDEa-001
- IDEa-001 has successfully cleared Phase I
- An additional investment of $10.2 millions required to progress to Phase II of clinical development
    - Phase I: discovery and preclinical testing, where specificity of antitumor activity and toxicity are initially tested in animal models
    - Phase II: carrying out studies in patients of selected tumor type to estimate efficacy compared to historical control and confirm optimal therapeutic dosage
    - Enlarged Phase II/Phase III: larger studies aimed at head-to-head comparison of the drug in development with the then-best-available therapy.

Possible scenarios for IDEa-001 at the end of Phase II

Allowable scenarios
at the end of Phase II trials



Standard of care

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Inputs to the DCFs stemming from the four allowable scenarios

INPUTS TO Discounted Cash Flow (DCF) model	WORST SCENARIO	BASE CASE safety -; response rate +	BASE CASE safety+; response rate -	BEST SCENARIO	SOURCES
Follicular Lymphoma (FL) patients in US and 5 major EU Countries	36,727	36,727	36,727	36,727	Globocan IARC WHO www.globocan.iarc.fr
Annual growth rate	1.5%	1.5%	1.5%	1.5%	Globocan IARC WHO
Indication (s)	Abandon development	Third line	Third line, patients in poor status	Second line	IDEaTION strategic assessment
Patients treated (% of total FL patients)	-	10.5%	3.5%	33%	IDEaTION estimate
IDEa-001 peak share	-	15%	50%	15%	IDEaTION estimate
First approval & launch	-	Year 3	Year 3	Year 3	IDEaTION estimate
Patent expiration	-	Year 16	Year 16	Year 16	IDEa-001 IND filing
Net effective price per patient	-	$100,000	$100,000	$75,000	IDEaTION targets based on the inverse correlation between incidence and price
Probability rate of marketing approval	-	50%	50%	50%	Global Data attrition analysis www.globaldata.com
R&D investment to complete PII	$10.2 mill	$10.2 mill	$10.2 mill	£10.2 mill	IDEaTION estimate
Incremental R&D investment to complete development	-	$44 million	$44 million	$44 million	IDEaTION estimate
Annual cost of pharmaco-vigilance	-	$2 mill	$2 mill	$2 mill	IDEaTION estimate
Annual incremental fixed capital investments	-	Up to $2 mill in Year 5; $1 mill thereafter	Up to $2 mill in Year 5; $1 mill thereafter	Up to $2 mill in Year 5; $1 mill thereafter	IDEaTION estimates of capital required to scale-up and to maintain supply after approval
Basis for probabilised costs	-	revenues	revenues	revenues	Probability-adjusted revenues
Cost of Goods Sold	-	20%	20%	20%	IDEaTION estimate based on small scale PI manufacturing costs
Sales & Marketing costs	-	10%	10%	10%	Global Pharma: biotech industry average
Other operating expenses	-	5%	5%	5%	Global Pharma: biotech industry average
Effective tax rate as % of EBIDTA	-	35%	35%	35%	IDEaTION estimate
Discount rate	-	12%	12%	12%	Global Pharma (+4% illiquidity premium)

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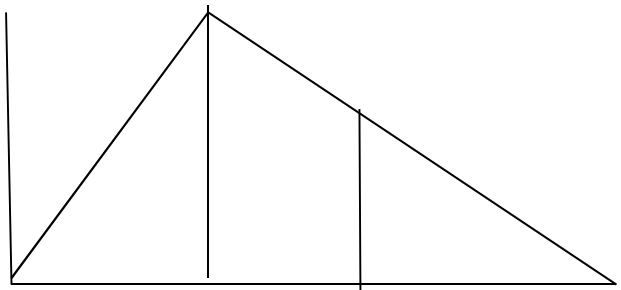
Graphical representation of IDEa-001's real option value of Phase II investment

Real Option price: $10.2 mill
(cost of PII development trials)



No clinical benefits foreseeable. Highly unlikely to receive regulatory approval.

ABANDON DEVELOPMENT

WORST
$0 mill

3rd line FL patients
60% probability response rate +
40% probability safety +
Price 100k USD

GO TO P III

BASE
$11.8 mill

2nd line FL patients
Peak share: 15%
Price: USD 75k

GO TO P III

BEST
$78.9 mill

Real Option value= $21.0m

The real option value obtained with the pay-off method was absolutely comparable to the option value calculated through Black & Scholes formula, showing a negligible difference of 1.3%.

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Advantages

- The pay-off method quantifies the value implications for the organization of the 2 x2 scenario matrix
- **The pay-off method is based on fuzzy distribution of possibilities. It does not require to calculate volatility.**
- The application of the pay-off method is consistent with the main objective of scenarios
- The two techniques – deductive scenarios and pay-off method – speak a language familiar to management
- Together, they are likely to improve the understanding of uncertainty and competitive dynamic environment

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Conclusions

- Our model can be extended to virtually ant strategic investment decisions, by simply changing the key variables to use as the axes of the 2 x 2 scenario matrix (e.g., the market share and the market size of a new product, or maturity and interest rate of financial instruments)
- The model can be extended to other traditional domains of application of real options, such as mergers and acquisitions (Krychowski and Quelin, 2010) and IPO pricing
- The pay-off method is being developed from the current triangular approach to a trapezoidal approach

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