Significance of Risk Quantification

The Smart Decision-making Process

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- 20 years Project Mgmt Experience;

- Large Oil & Gas Constr. Projects;

- Graduate Degree From U.K. in Project Management

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“Risks” in Mega Oil & Gas Projects

- Risk Management Application – Essence of PRM
- Project Selection to Execution – Process Mapping
- Quantitative @RISK Applied - Execution Phases

- FEL (front-end loading) Phase Challenges
- Current Decision Theories (DSS)
- Proposed Decision Method (RISCOR™)

- Integration: Qualitative and Quantitative Methods

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Time Magazine – Alberta Oil Sands

" Canada's greatest buried energy treasure" and " could satisfy the world's demand for petroleum for the next century"

140,800 sq. km in 3 major areas of Alberta involving oil giants;
34.8% of all crude oil and equivalent in Canada – sweet oil down;
$125 Billion allocated towards its developments in next decade;

However, over US$800 Billion will be invested to 920 new GCC Oil and Gas projects in the middle eastern region…

IQPC - 2007

Energy Sectors	Number of Projects	Total Capital Investment
Mining	5	CN$ 1,795 Million
Oil & Gas	12	CN$ 1,950 Million
Oil Sands	51	CN$ 96,584 Million
Pipeline	29	CN$ 7,005 Million
Power	21	CN$ 5,727 Million
TOTAL	**118**	**CN$ 113,061 Million**

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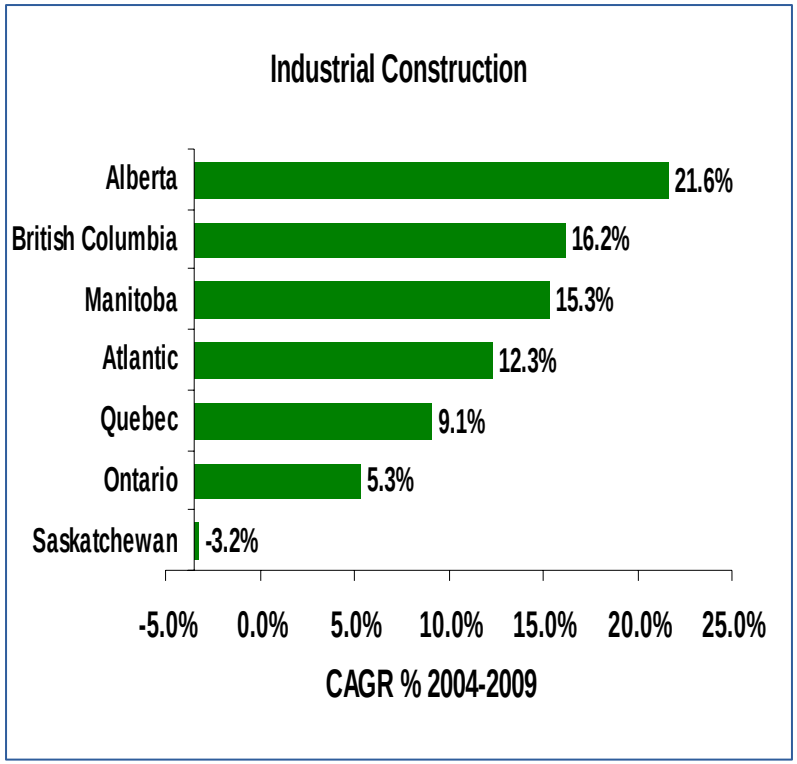
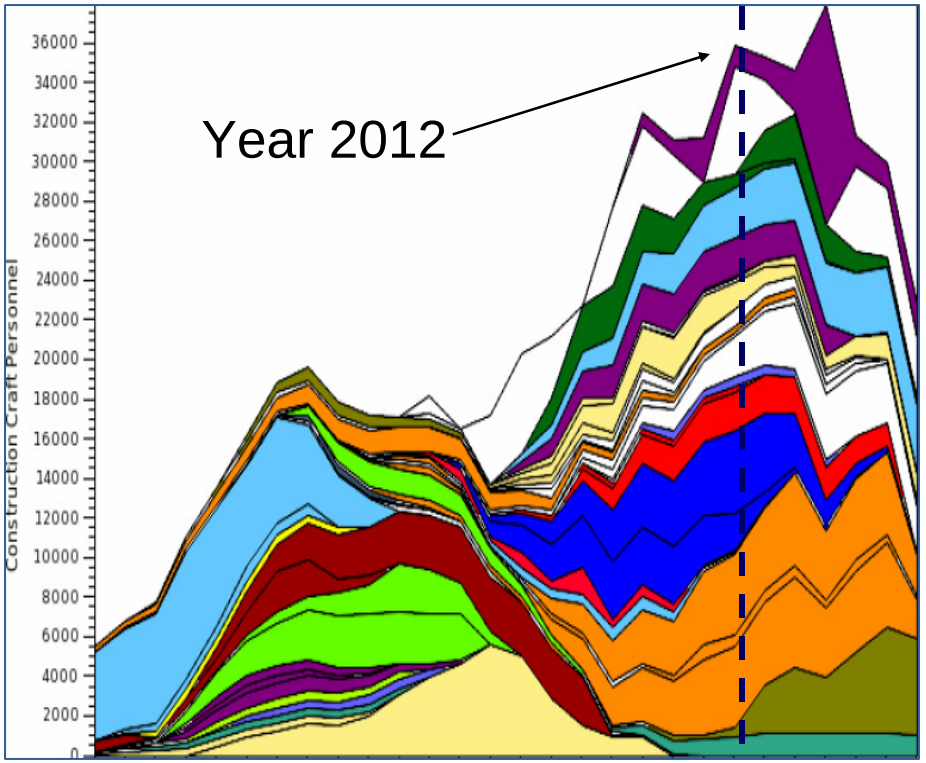
Global Insight 2006 – Workforce



COAA 2006 Alberta Labor Forecast



Risk #1: Workforce Recruiting
Training
Retaining

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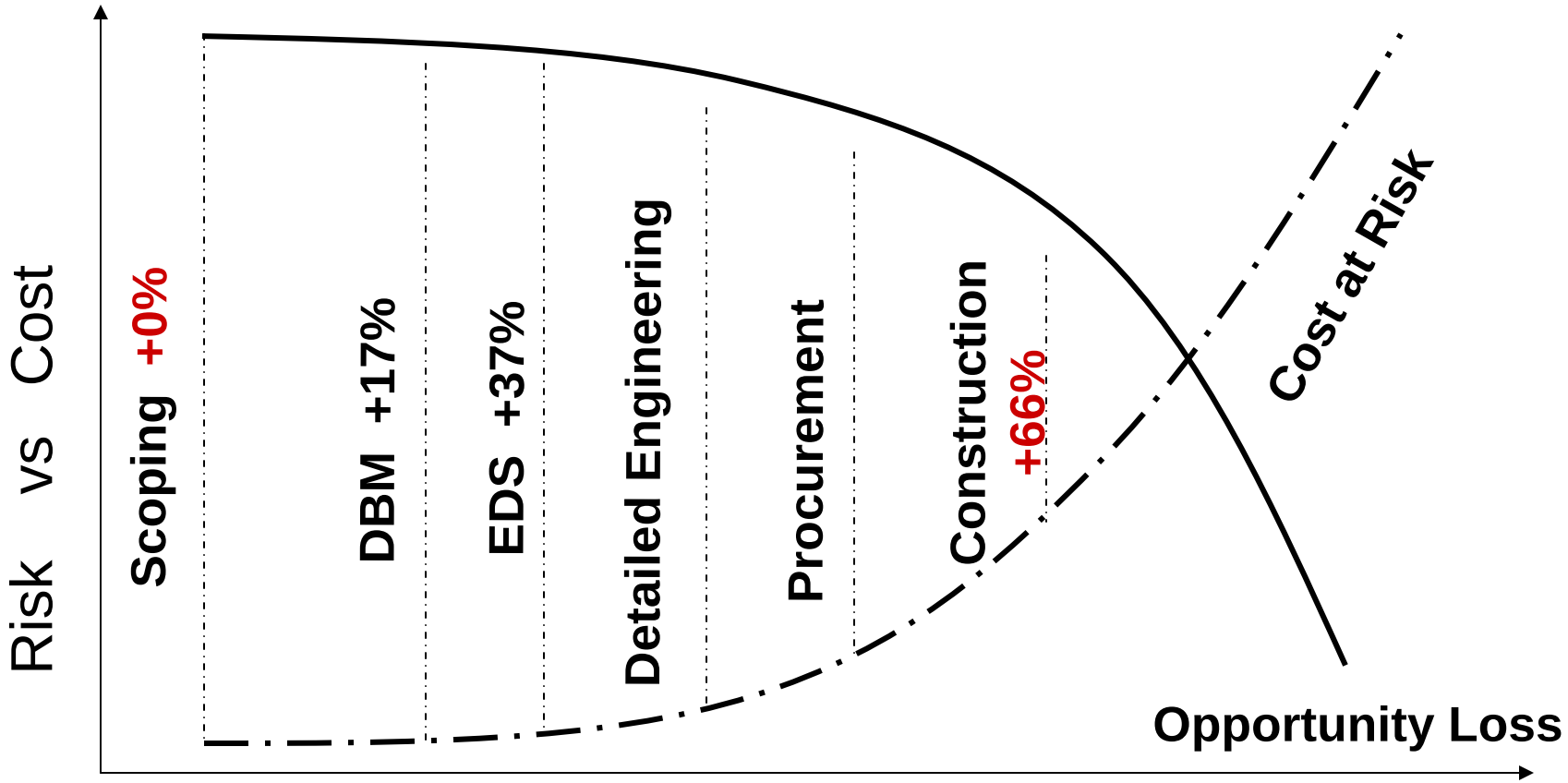

Risk #2: Cost Pressure

Overruns

Unpredictable

What does Project Risk Management include?

- Implemented rigorous project risk management process
- Mandatory Project Risk Identification and Registry
- Qualitative Risk Assessment using pre-established Risk Matrix
- Quantitative Risk Analysis for Cost Estimates using @RISK
- Quantitative Project Schedule Evaluation using PertMaster
- Periodical Implementation Audits on Risk Tracking and Monitoring
- Active Management and controls of Level I / II High Severity Risks

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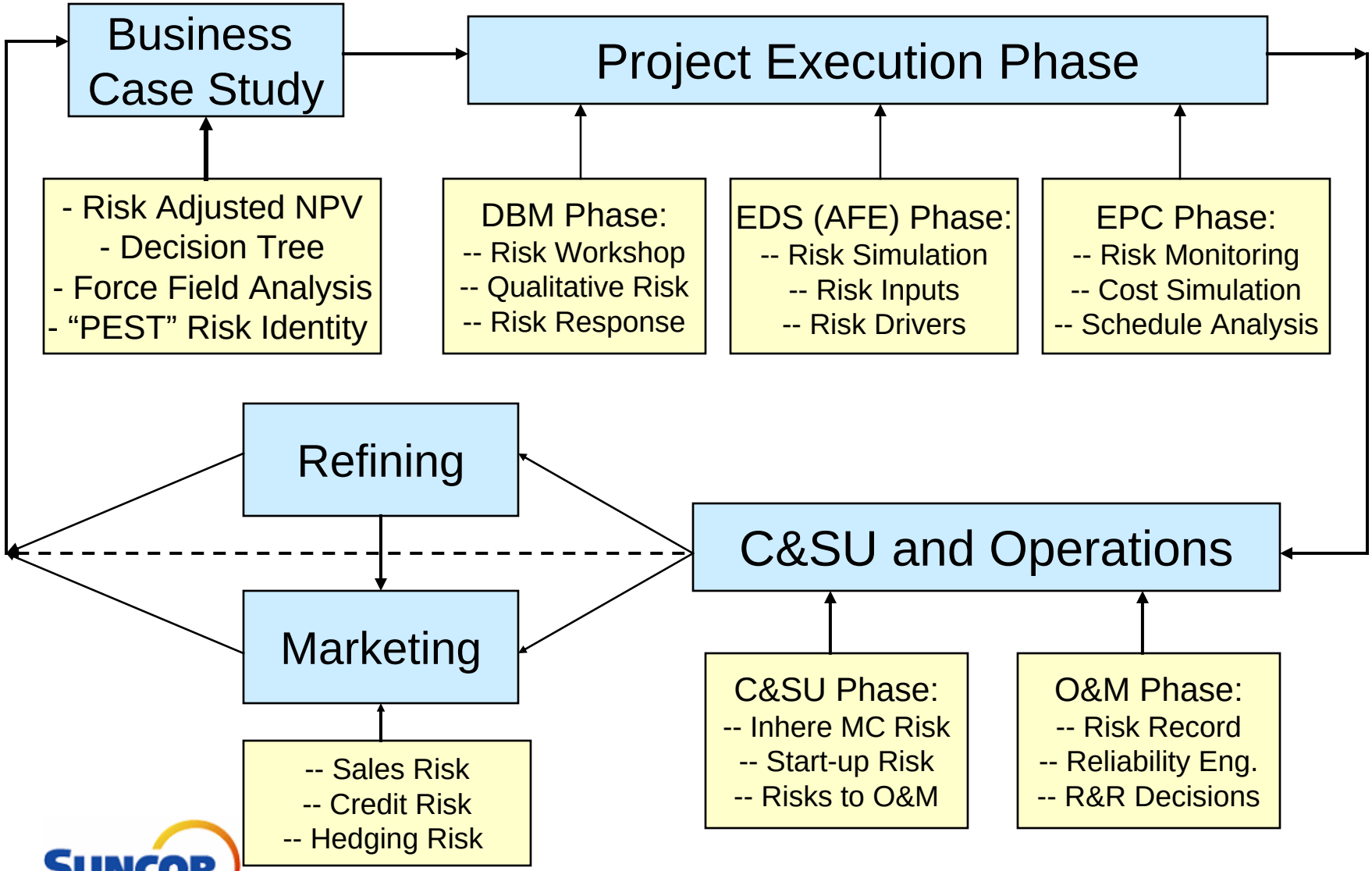


Project Execution Phase

EDS (AFE) Phase:
-- Risk Simulation
-- Risk Inputs
-- Risk Drivers

Risk Register

Cost Estimate

Risk Experts

@RISK Monte Carlo Simulation "Black Box"

Mystified Contingency $$

Tornado Chart
Risk Drivers

Great !

Project Mgr.

Application of Quantitative @RISK Simulation in Estimating

Monte Carlo Simulation for Cost Estimate Demystified

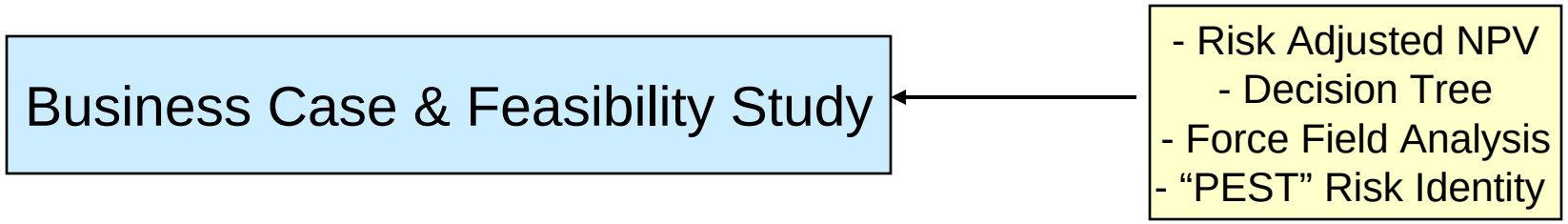
No	Estimate Items	ESTIMATE DETAILS Data	Comments	5 Low	95 High	@P70 value Monte Carlo	F - E Contingency
1	**Install Pipes on Racks**						
	Pipefitter Wage rate	50	(A) $/Hr			50	
	Labour Productivity	1.0	(B)	0.90	1.25	1.11	
	Estimated Manhours	1,500	(C) Manhours			1,500	
	Total Pipe Installation Cost	**75,000**	D1=AxBxC			**83,587**	**8,587**
2	**Field Construction Indirects**						
	Temporary Facilities	15,000	(A) Lumpsum			15,000	
	Small Tools & Equipment	20,000.0	(B) material	19,000	24,000	21,975	
	Janitorial Labour	8,000	(C) Labor			8,000	
	Total Indirect Cost	**43,000**	D2=A+B+C			**44,975**	**1,975**
3	**Home Office Engineering**						
	Engineering Staff Wage rate	85	(A) $/Hr			85	
	Engineering Productivity	1.00	(B)			1	
	Estimated Manhours	600	(C) Manhours	550	700	643	
	Total Pipe Installation Cost	**51,000**	D3=AxBxC			**54,695**	**3,695**
	Total Estimated Cost	**169,000**	E=D1+D2+D3		F=TIC$	**183,257**	**14,257**

A

B

C

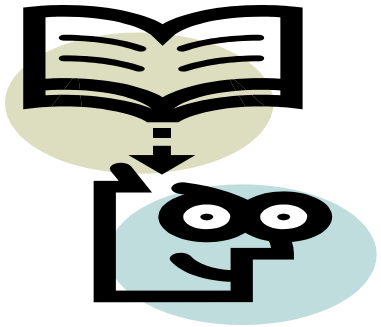
D



Front End Study requires a lot of data and reliable information to make smart and right decisions, but the opposite is true.

- Little known facts – Too early and expensive to collect "facts";
- Subjective Assumptions – Heuristics and experience based ;
- Adventurous in nature – Driven by survival, growth and competing;
- Unknown locale or unproven new technology – Profit driven for IRR;

- Many Options and Choices make decisions complex and difficult;
- Risks and Uncertainties bubbled around each option are dense;
- Decision-makers are pressured to make "quick" business decisions;



Many scholars and researchers have Done Much studies on Decision-making

However, decisions often involve risks

- "Decision analysis is the discipline for helping decision-makers choose wisely under conditions of uncertainty." (J. Schuyler, 2001)
- "Any decision making should attempt to account for the future" (D. Woods, 1975)
- "There is a lag between academic modeling and industry implementation. many models are now first developed in industry". (P. Fusaro, 1998)
- "With randomness in demand, the deterministic EOQ model seems pretty unpalatable…the Poisson distribution of demand…". (A. Manne, 1961)
- "Lacking skill guidance, decision makers may instinctively resort to 'irrational' but quite believable attitudes & modes of thought in making risky decisions". (A. Baker, 1981)

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Decisions under Uncertainty

- Decision outcomes are controlled by forces of "state of nature".

- Bayes/Laplace: The highest probability weighted average payoff
- Hurwicz: The highest of best and worst outcomes with attached probability
- Maximin / Minimax: Strategy with "best worst" cautious / pessimistic outcome
- Maximax: Strategy of "best best" payoff with reckless / optimistic outcome
- Minimax Regret: The highest regret is lower than that of any other strategy

Decisions under Risk Conditions

- Decisions through utility function theory can be made numerically

- Decision makers generally estimate likelihoods for the various possible outcome of their actions.

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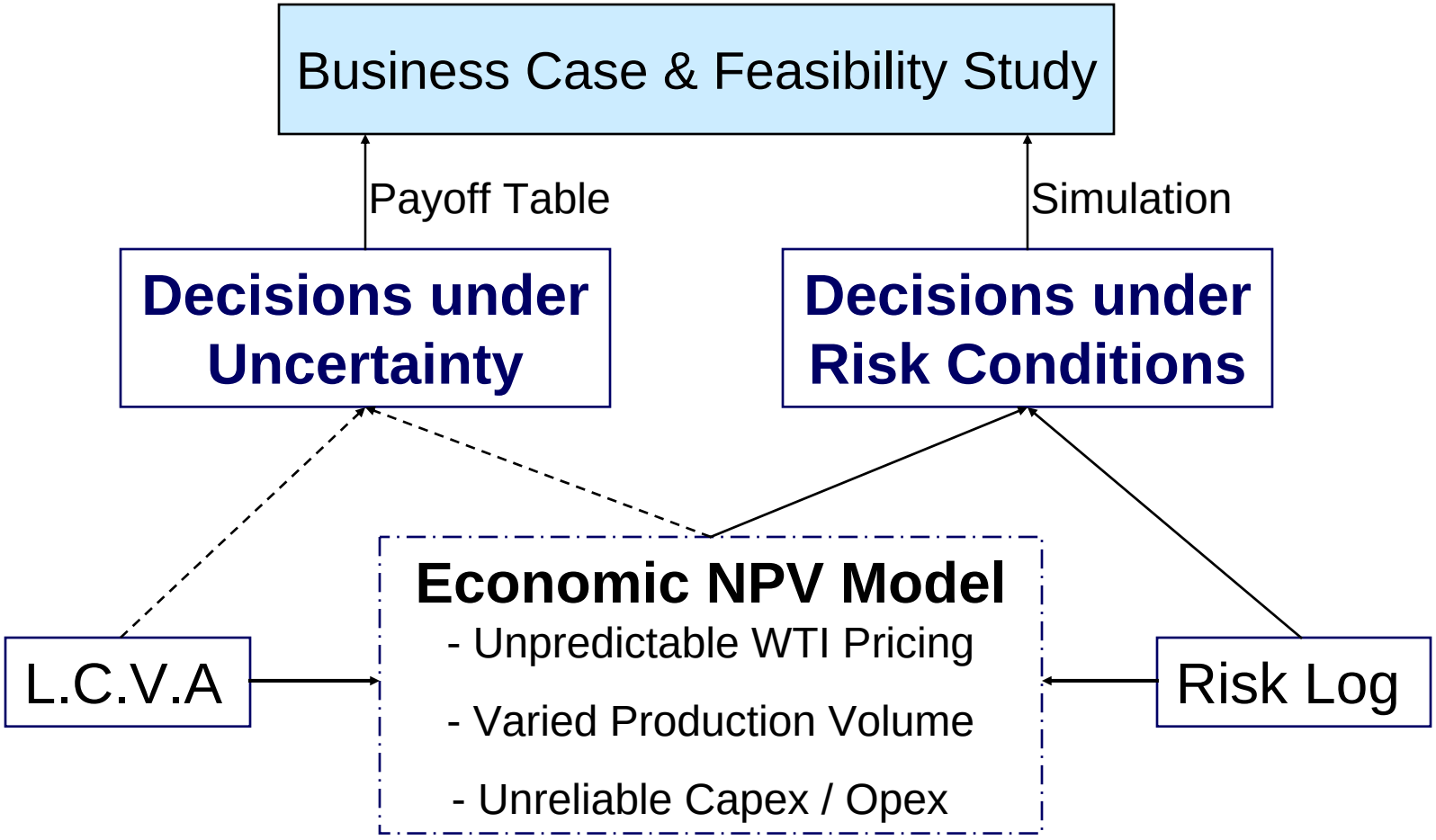

The Traditional NPV-based Scenario Approach

Models are built from necessity, and a decision model is any quantitative or logical abstraction of reality that is created and used to help somebody make a decision.

Samuel Bodily (1985)

Total uncertainty is the combination of uncertainty and variability. These two act together to erode our ability to predict what the future holds. There are techniques to quantitatively describe epistemic uncertainty associated with the parameters of a model.

David Vose (2000)

Five decision-making strategy: (1) acquiring experience & expertise; (2) Debiasing judgment; (3) Taking an outsider's view; (4) Using linear models based on expert judgment; (5) Adjusting intuitive predictins.

Max Bazerman (2002)

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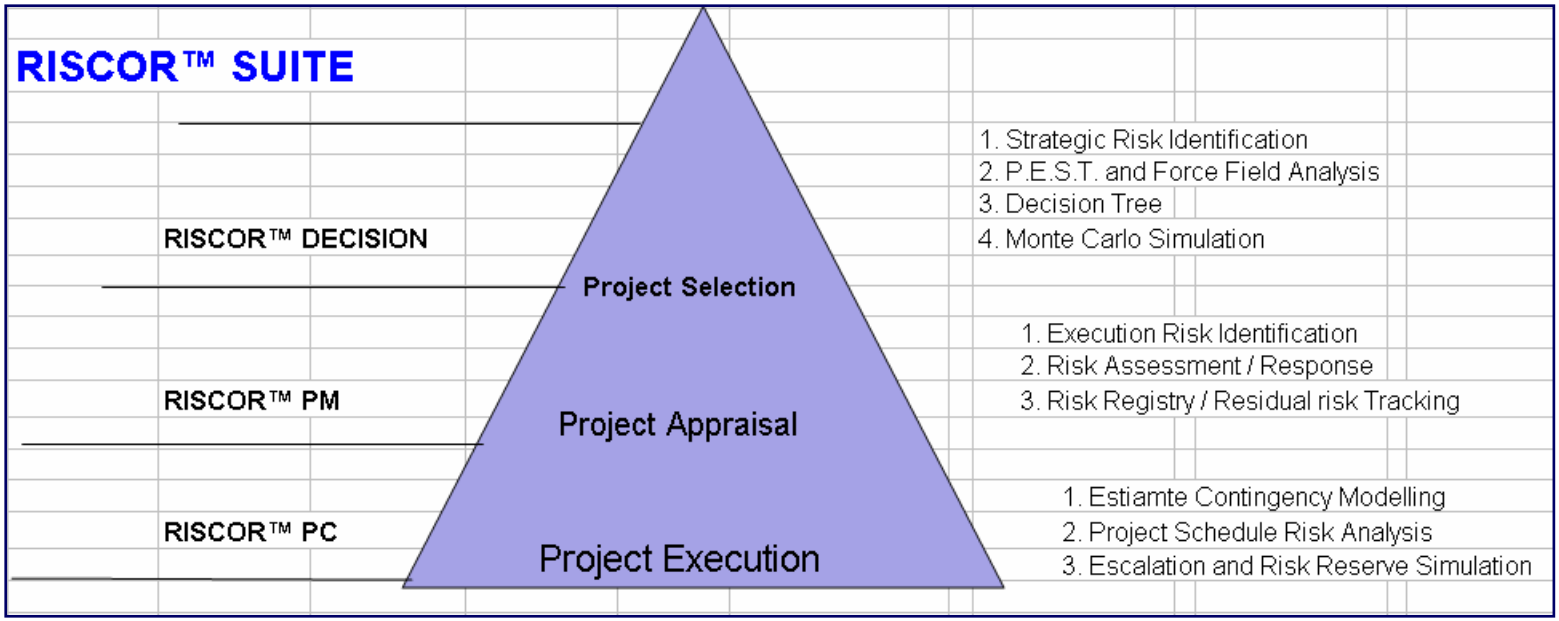
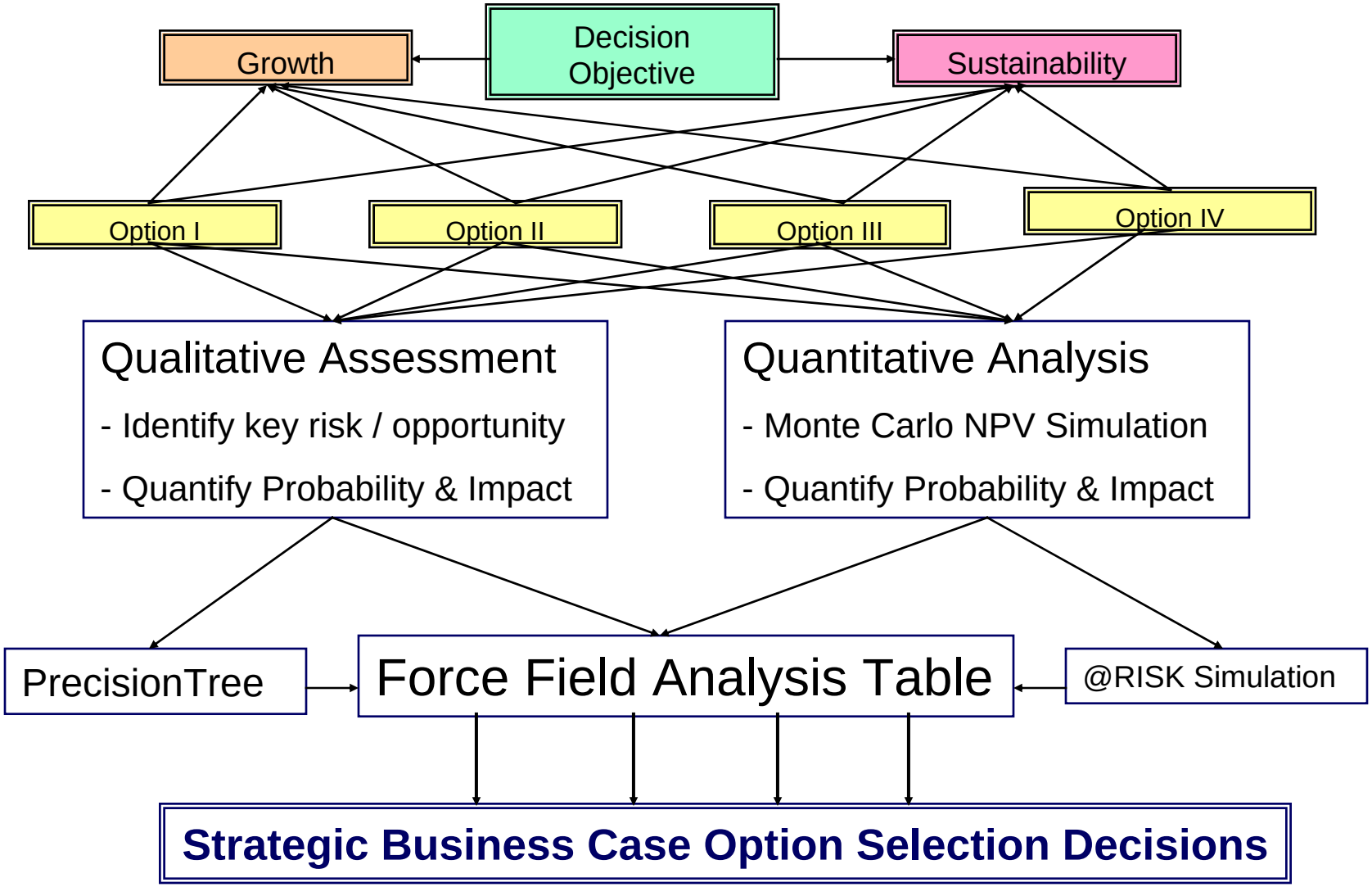
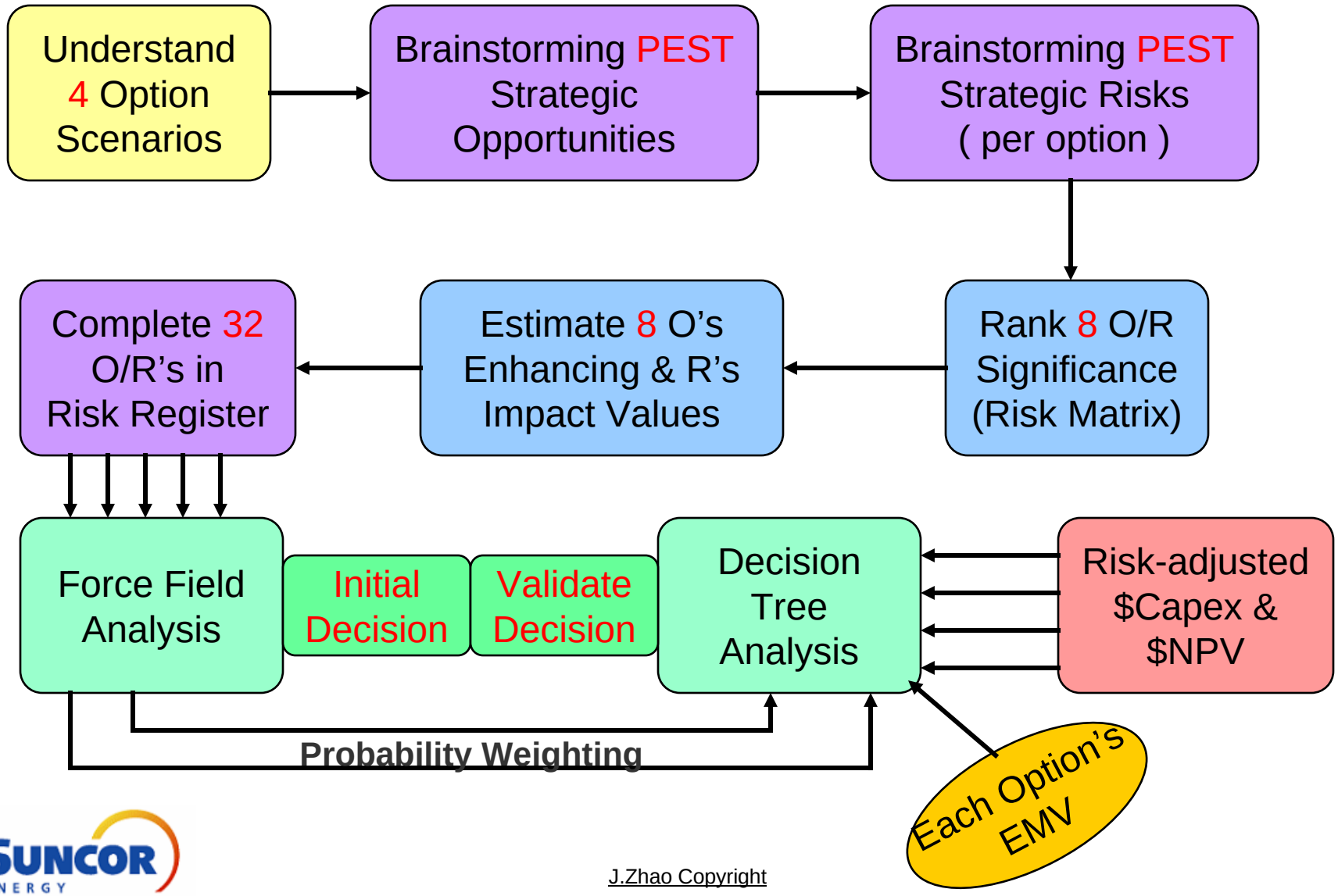
Proposed Risk Management Integration (RISCOR™)



* The Risk Core (the Core of Risk) is the quantification of identified risks for their consequences and probability of occurrence.
* Re-score deterministic estimates or decisions with stochastic values considering variables' variability and uncertainty.





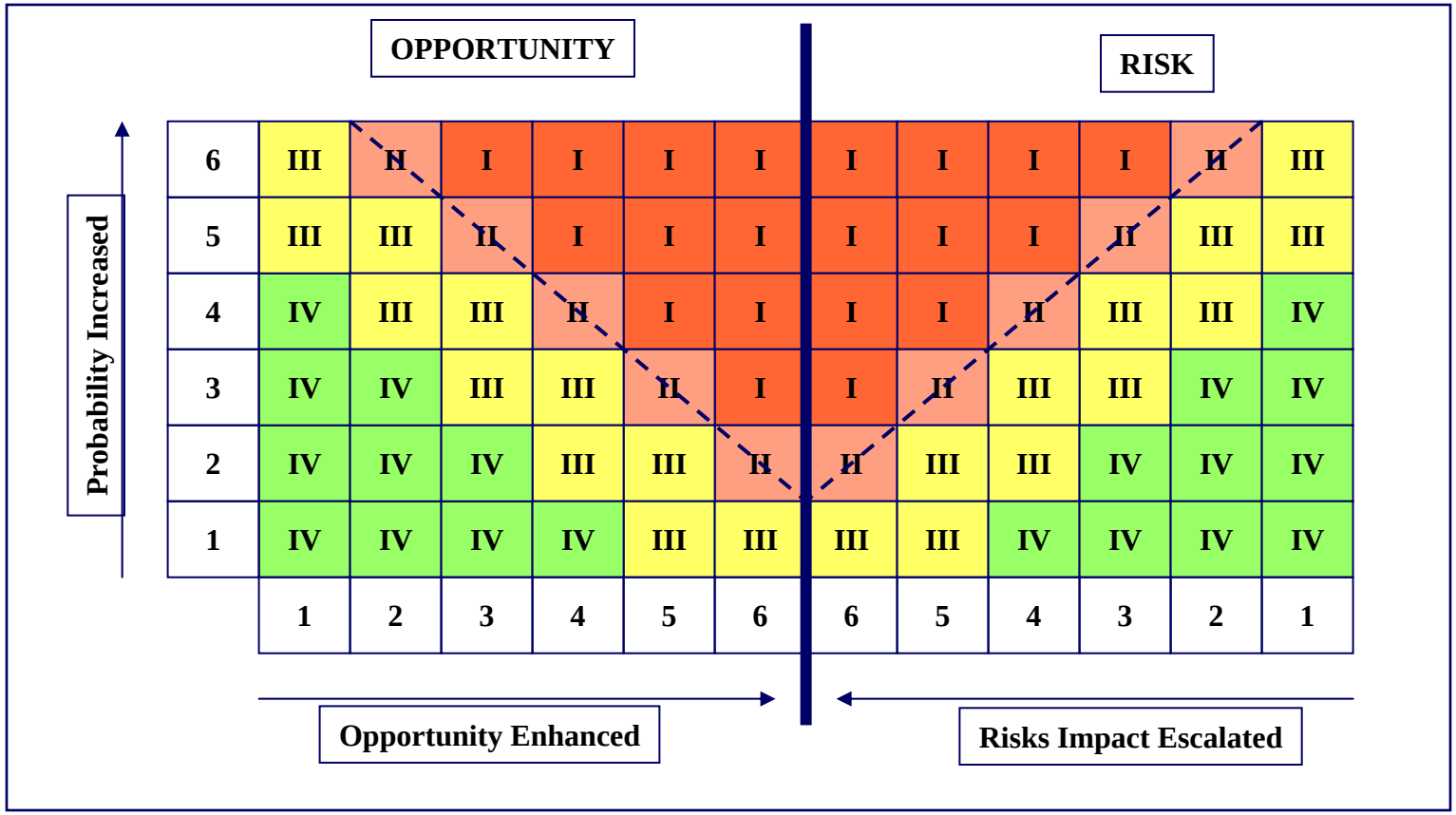
The Force Field Analysis objectively calculates each option's net force based on scores of each Risk and Opportunity identified. Formulae:

Probability x Consequence + Reliability + Priority

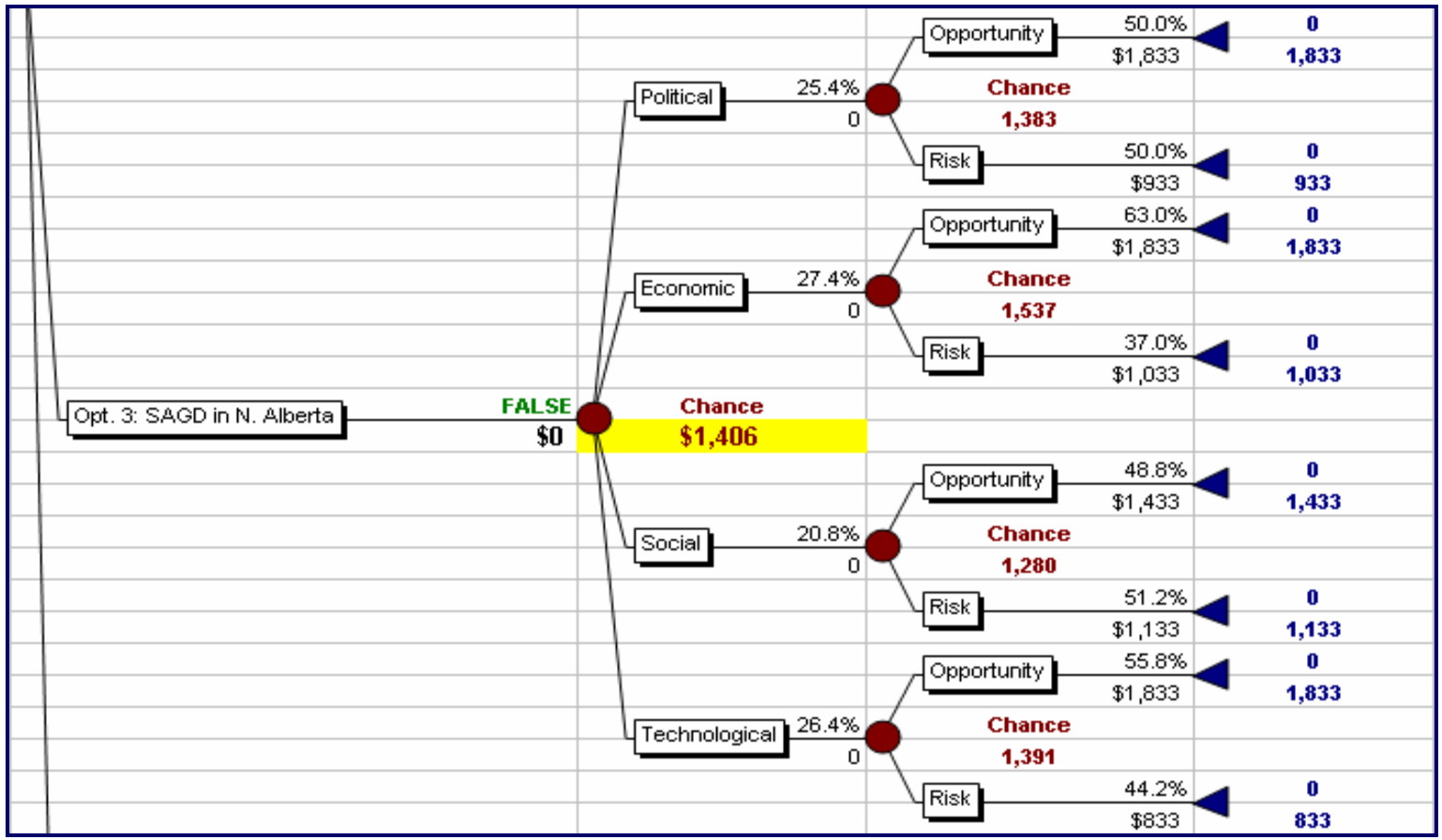
		Option 1 Building New SAGD Oil Sands Project in N. Alberta			Scenario:	Complete the program by 2020 with total 100k bpd production with SAGD technology; no new technology breakthrough is expected.		
					IRR Target			12%
Value $		Opportunities - For →		Force Field		← Against - Risks		Impact $
$500	1PO	favorable treatment due to provinces desire to preferentially develop large		15	-24	pressure to reduce NG, GNG Emissions/Carbon Tax,	1PR	$300
$450	1EO	in product due to flexibility in marketing (reduced upgrading costs)		30	-29	Gas Price/Oil Price, CAPEX, Labour Productivity,	1ER	$500
$350	1SO	Reduced Footprint / Ecological Impact = Better company image		23	-28	attract/retain skilled workforce. Community reaction to	1SR	$100
$400	1TO	Upside realized as knowledge of process/reservoir increases.		24	-22	performance and understanding of the geotechnical issues.	1TR	$500
$1,700		Benefit SUM (1)		92	-103	Impact SUM (1)		$1,400
		NET FORCE		-11				

(64) Opportunity / Risk Identification								In
URI	Risk Description	O/R	O/R	Probability	Impact Assessment (I - VI)			
#	Symptoms and Root Causes	Initiator	Recipient	(A): I - VI	Envi.	Econ.	Social	
1PR	Policy Change - EIA approval process threatened due to environmental pressures (water, emissions, energy, etc.)	Team 1		2		6		
1PR	**Natural Gas Intensity - Political pressure to reduce NG, GNG Emissions/Carbon Tax, Commodity Decoupling/NEPII (National Energy Program)**	**Team 2**		**5**	**4**	**4**	**4**	
1EO	**Share Value/Credit, Increased value in product due to flexibility in marketing (reduced upgrading costs)**	**Team 1**		**5**	**1**	**5**		
1EO	Share holder confidence, improves as Firebag demonstrates oil production.	Team 2		5	0	0	3	
1ER	Skill level of workforce, Attraction/retention of skilled workforce due primarily to remote location.	Team 1		5	3	3	4	

Identified Risks and Opportunities must be quantified for its “P” And “C” in order to calculate a “Score” for the comparison of Risk Severity, based on Risk Matrix.



The Risk Matrix must be established using proper scales;
The Matrix must comply with company's Risk Tolerability;



Many business people are cognizant with PrecisionTree;

Monte Carlo Net Present Value (NPV)

KEY INPUTS:	Description	Formula (EV)	Unit	Base Case	Distribution Function	Standard Deviation	Opptimistic (Low)	Pessimistic (High)
							10	90
1	Currency Exchange	1.3	Ratio	1.2	Trigen Dis.		0.92	1.2
2A	Average WTI Price Line	41.7	$/BBL	40.00	Trigen Dis.		0.9	1.2
2B	Average NG Price	6.6	$/MBTU	6.50	Trigen Dis.		0.85	1.2
2C	Average Crack Price	4.1	$/GL	4.00	Trigen Dis.		0.85	1.2
2D	CO2 Emmission Pricing	11.2	$/Ton	11.00	Trigen Dis.		0.85	1.2
3	Designed Plant Life	35.1	Years	33.0	Trigen Dis.		0.9	1.25
4	Operating Cost	7.8	$/BBL	$6.8	Trigen Dis.		0.98	1.35
5	Maintenance Cost	0.1	% of TIC	7.0%	Trigen Dis.		0.9	1.25
6	Inflation Factor	0.0	Annual	2.0%	Trigen Dis.		0.9	1.25
7	Total Capex (Investment)	958,405.2	Thousands	900,000	Trigen Dis.		0.95	1.2
8	Crown Royalty Rate	0.3	%	25.0%	Trigen Dis.		0.9	1.25
9	Crown Minimum Payment	0.0	%	1.0%	Trigen Dis.		0.9	1.25
13A	CCA Class 41	1.0	%	100%	Trigen Dis.		1	1
13B	CCA Class 43	0.2	%	20%	Trigen Dis.		1	1
13C	COGPE	0.2	%	20%	Trigen Dis.		1	1
14	Annual Volumes	47,908.5	Kbbls	45,000	Trigen Dis.		0.9	1.25
15	External Risks (EMV)	53,231.6	Thousands	50,000	Discrete		0.9	1.25

KEY OUTPUTS:	Description	DCF Rate	NPV Value Mean (EMV)	NPV Value @ P70	IRR Mean (EMV)		Option I	Option II
Scenario I	NPV @	10%	**2,513,607**	**7,828,762**				

* Only stochastic NPV model can truly reflect the practical reality;

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Decision Criteria		Option I		Option II		Option III		Option IV	
Probability-weighted & Impact assessed Rankings		SAGD Project in N. Alberta - Oil Sands		SAGD Project in S. Alberta - Oil Sands		SAGD Project in E. Alberta - Oil Sands		SAGD Project in W. Alberta - Oil Sands	
		Oppor.	Risks	Oppor.	Risks	Oppor.	Risks	Oppor.	Risks
P	POLITICAL	15	-24	30	-26	25	-25	22	-25
E	ECONOMICS	30	-29	24	-24	34	-20	19	-34
S	SOCIAL	23	-28	24	-28	20	-21	24	-28
T	TECHNOLOGICAL	24	-22	21	-20	29	-23	29	-35
	OPTION SUM	92	-103	99	-98	108	-89	94	-122
	NET SUM	-11		1		19		-28	
Subjective Opinion		0		2		15		2	
		Net Present Value							
P	POLITICAL	7,967		9,376		5,273		3,209	
E	ECONOMICS	7,942		9,274		5,426		2,855	
S	SOCIAL	8,062		9,085		5,169		3,067	
T	TECHNOLOGICAL	7,929		9,435		5,280		3,027	
Risk Adjusted NPV		$7,975		$9,286		$5,295		$3,075	
I.R.R.		38.0%		29.6%		25.2%		44.9%	

The Summary Table: Qualitative & Quantitative Results

Decision Key Points – An Integrated Approach

- It forms a balanced picture of the risks and rewards
- Visually lay out all options that can be challenged
- Framework to quantify probability-based outcomes
- Make best decision from scientific & intuitive methods
- It enhances and formalize the “common sense” method

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Conclusion / Summary

- Business Case Options must be studied against the following for a better decision making
  - *LCVA (Life Cycle Value Assessment)*
  - *Life Cycle Opportunities and Risks*
  - *Economic Returns (IRR or ROCE, NPV)*
- Risk containment and Opportunity enhancement are the essence of Risk Management
- Risk Management increases chances to succeed!

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Questions

and

Answers !

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Questionnaires

- Which Functions you are doing in managing projects?
  PM *PC* *PE* *CM* *Other*

- How many years of experiences working in risk-related businesses?
  < 5 years ***5 – 10 years*** ***>10 years*** ***>20 years***

- What was your knowledge level in risk decisions before the session ?
  High *Medium* *Low* *Minimum*

- How important is the risk concept in decision-making process?
  Very *Some what* *not very* *negligible*

- Are you ever involved in project selection decision-making process?
  Yes *Somewhat* *Not at all* *Not aware*

- How much do you understand Monte Carlo simulation?
  100% *75% - 50%* *50% - 25%* *<25%*

- How much you think decision quality is improved by using risk approach?
  100% *75% - 50%* *50% - 25%* *<25%*

- Can the integrated stochastic model help decision-makers yield “smarter” decisions?
  YES *NO*