

An Optimal Approach to Project Selection

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Introduction

- Process for Project Selection
- Integrates the use of three techniques:
 - A Decision Model - Analytical Hierarchy Process (AHP).
 - Monte Carlo simulation
 - Optimisation Algorithm (Linear Programming)
- Maximises 'value' of projects while complying with common funding or risk constraints.
- Minimises effort required to assess poor candidates
- Implemented in Microsoft Excel™
- Process has wide applicability

Context for Project Selection

- Discretionary internally funded projects
 - Strategic Initiatives
 - Organisational Restructure
 - Business Improvement
- Client funded projects
 - Profit maximisation under constraints

Two Stage Process

- **Benefit Analysis**
 - Assigning relative ‘strategic’ values to short-listed projects

- **Cost and/or Risk Analysis**
 - Costing and risk assessing stronger candidates iteratively
(increasing level of detail as candidacy strengthens)

Benefits Analysis: Advantages

Provides:

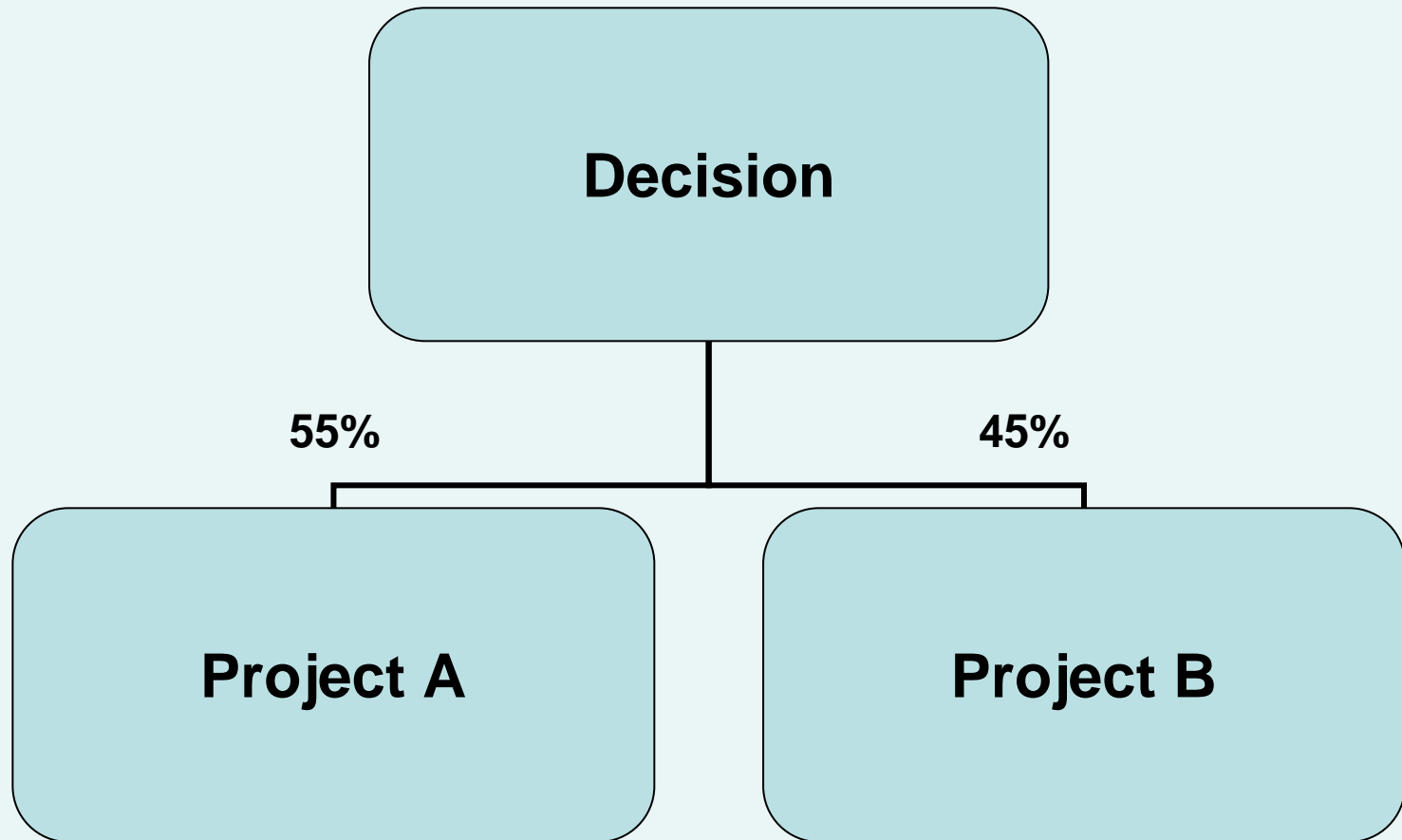
- A rational and self-documenting process for selecting initial project short-list.
- A clear comparison between the benefits of different candidate projects.
- Focused forum for consultation, buy-in and collaborative decision-making
- The means for distributed and autonomous decision-making.
- Transparency and accountability

Cost Analysis: Advantages

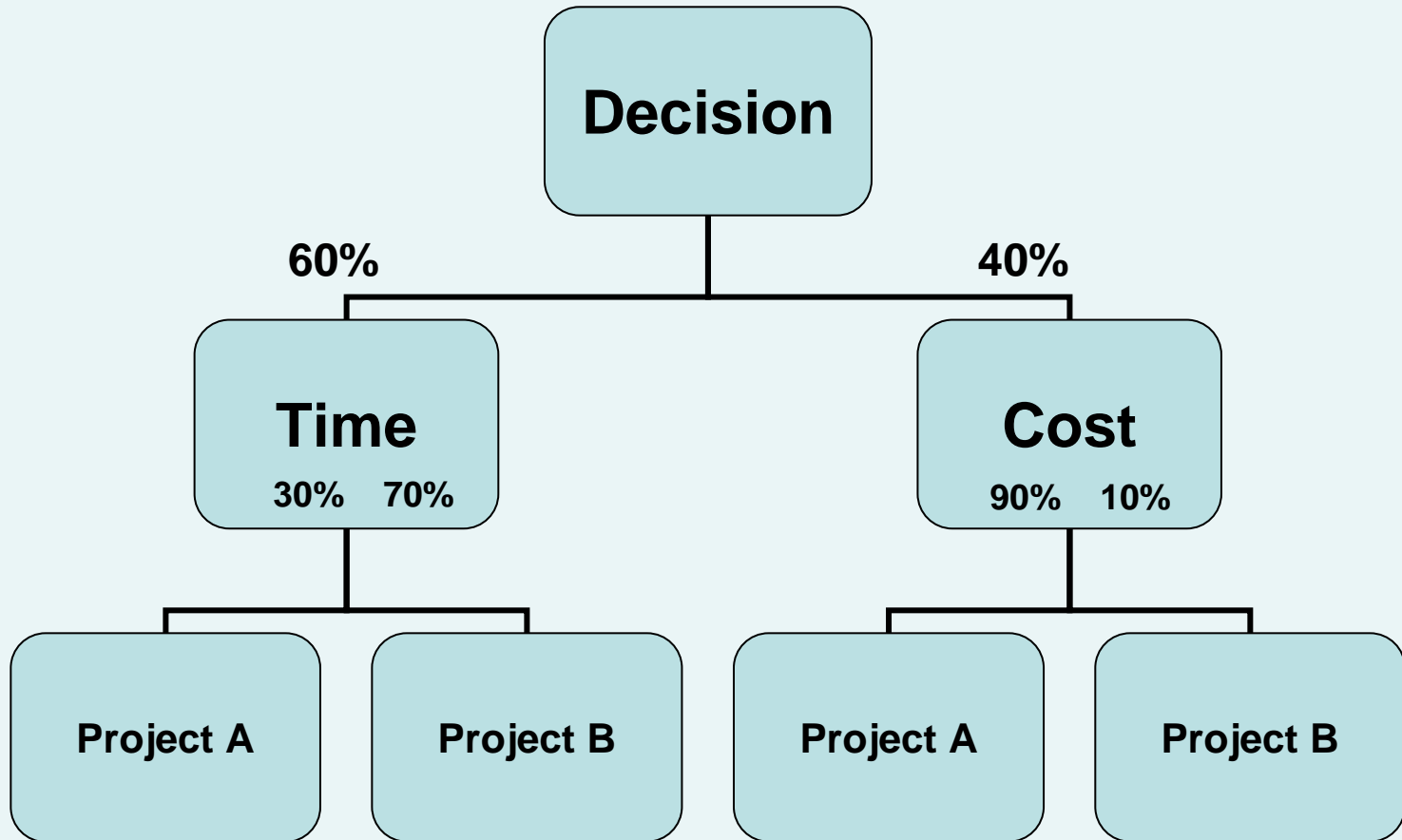
- Offers:
 - An ‘agile’ approach, minimising the effort spent costing projects that will not be selected
 - A ‘Find Failure Fast’ philosophy which roots out non-starters as quickly as possible
 - A ‘Ready Fire Aim’ approach
 - Select – Broad Plan – Evaluate – Re-select
 - Encourages iterative, non-linear and selective refinement.
 - A formulation leading to optimisation
 - Maximisation of ‘value’ subject to common constraints
 - Cost, Effort, Specialist Availability, Risk
 - Incorporation of uncertainty in estimates

AHP Decision Model

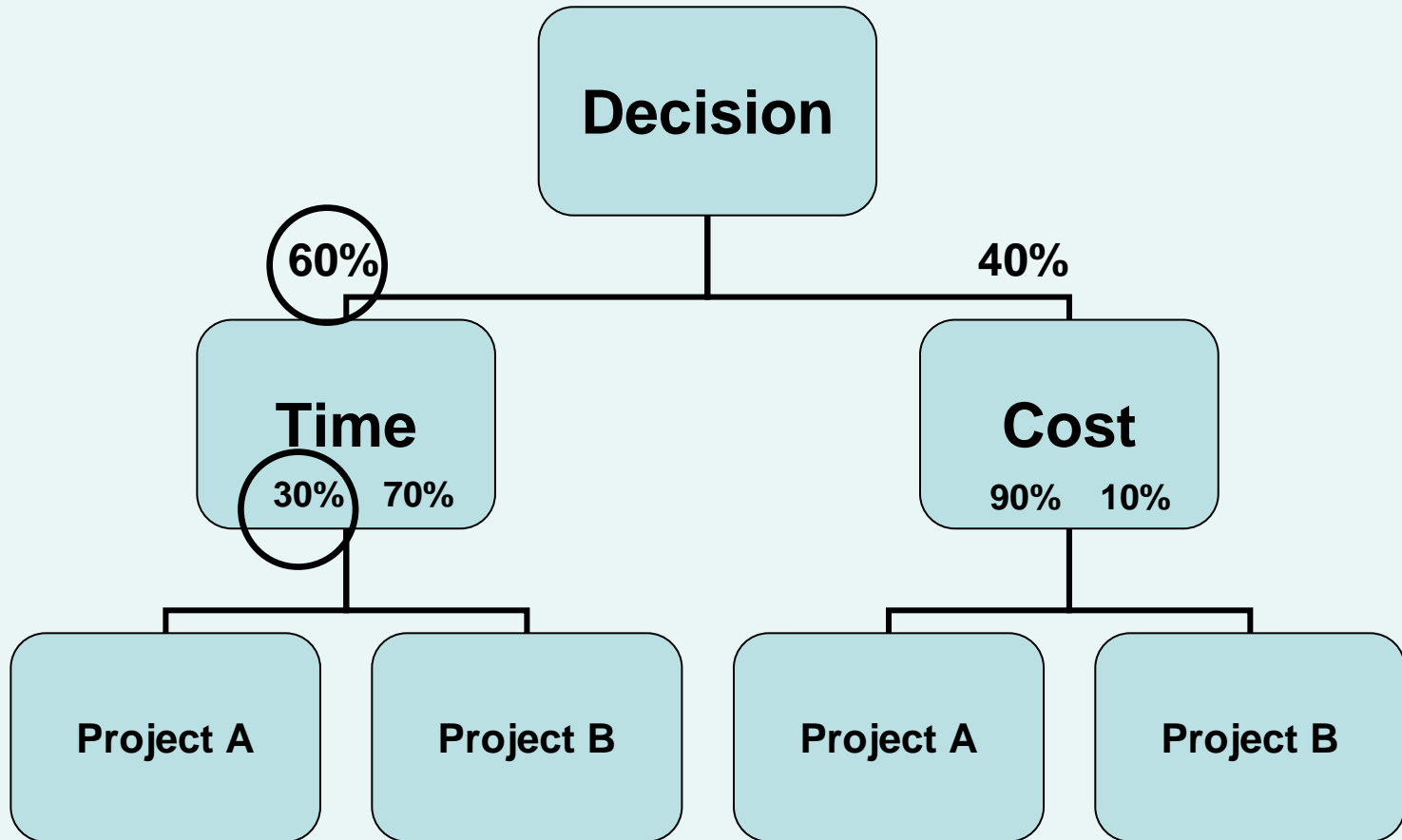
The Decision Hierarchy



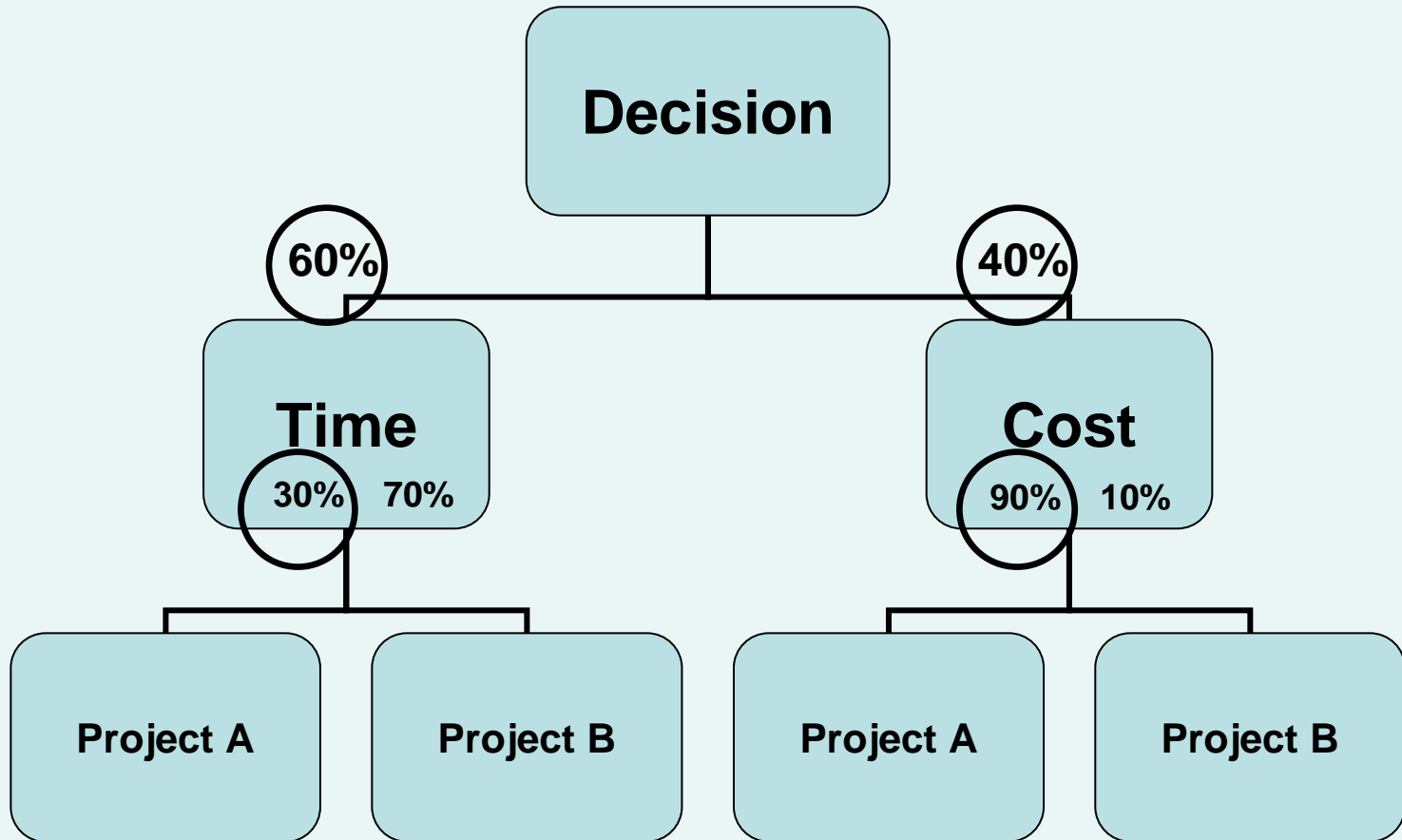
The Decision Hierarchy



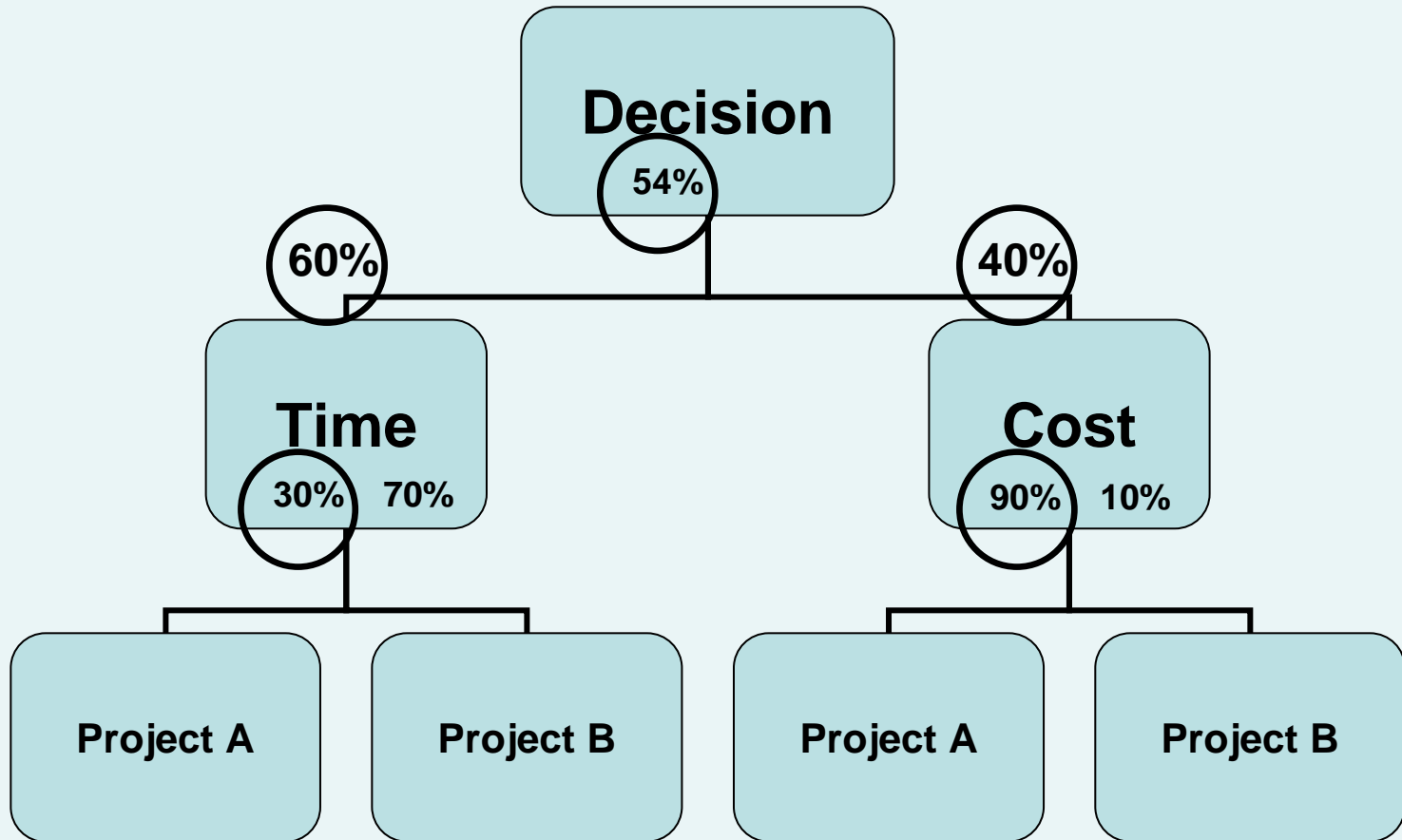
The Decision Hierarchy



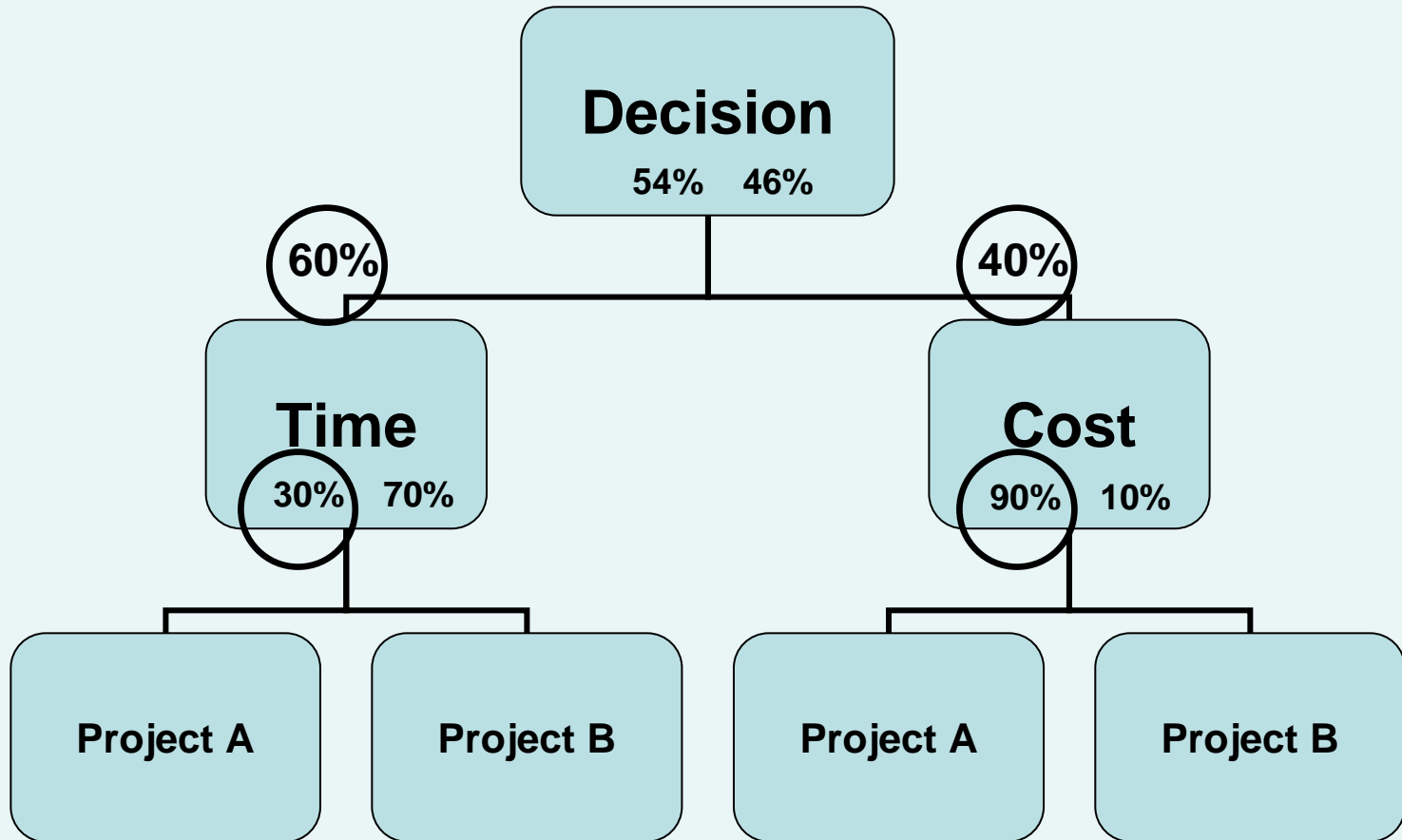
The Decision Hierarchy



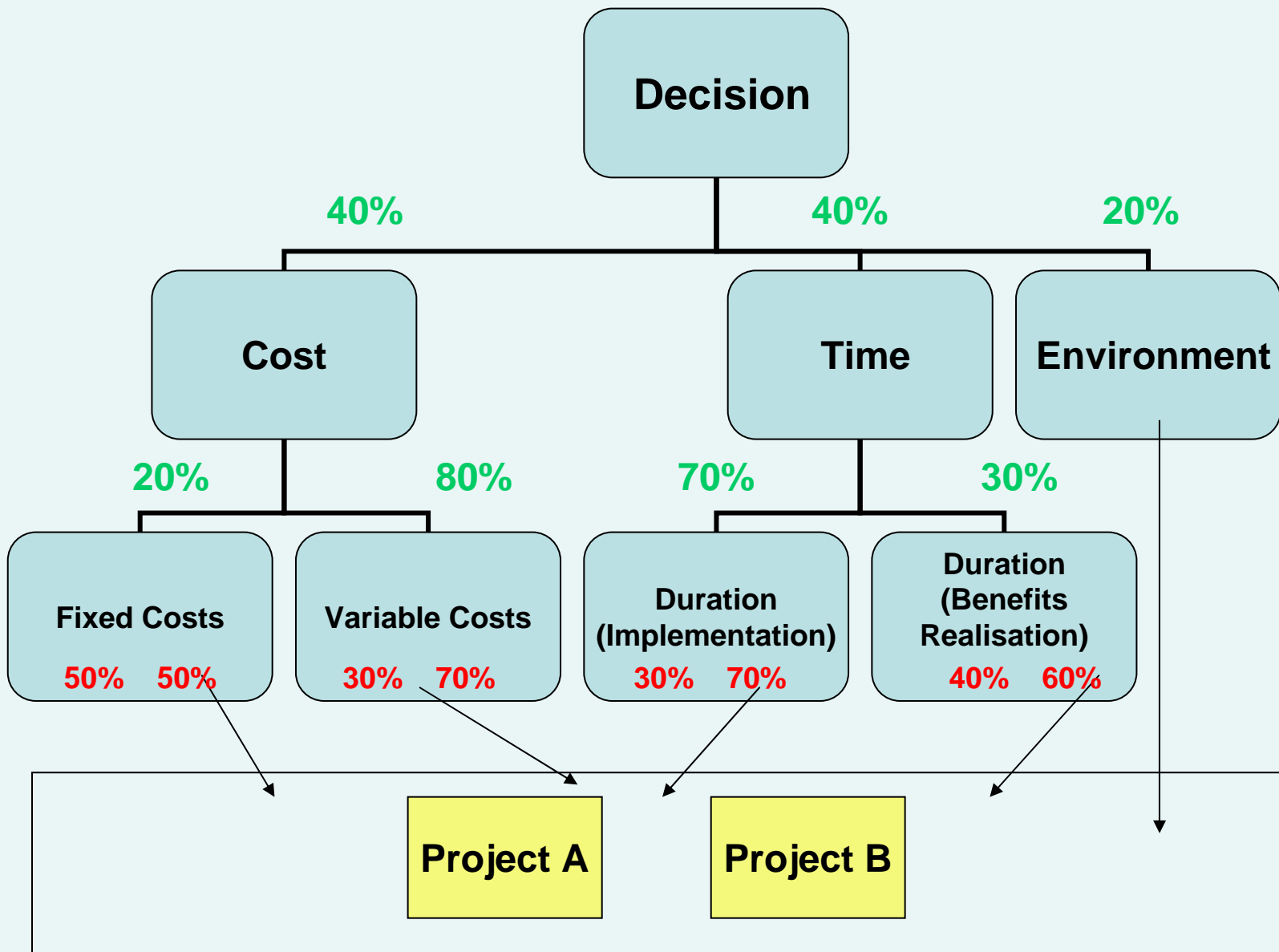
The Decision Hierarchy



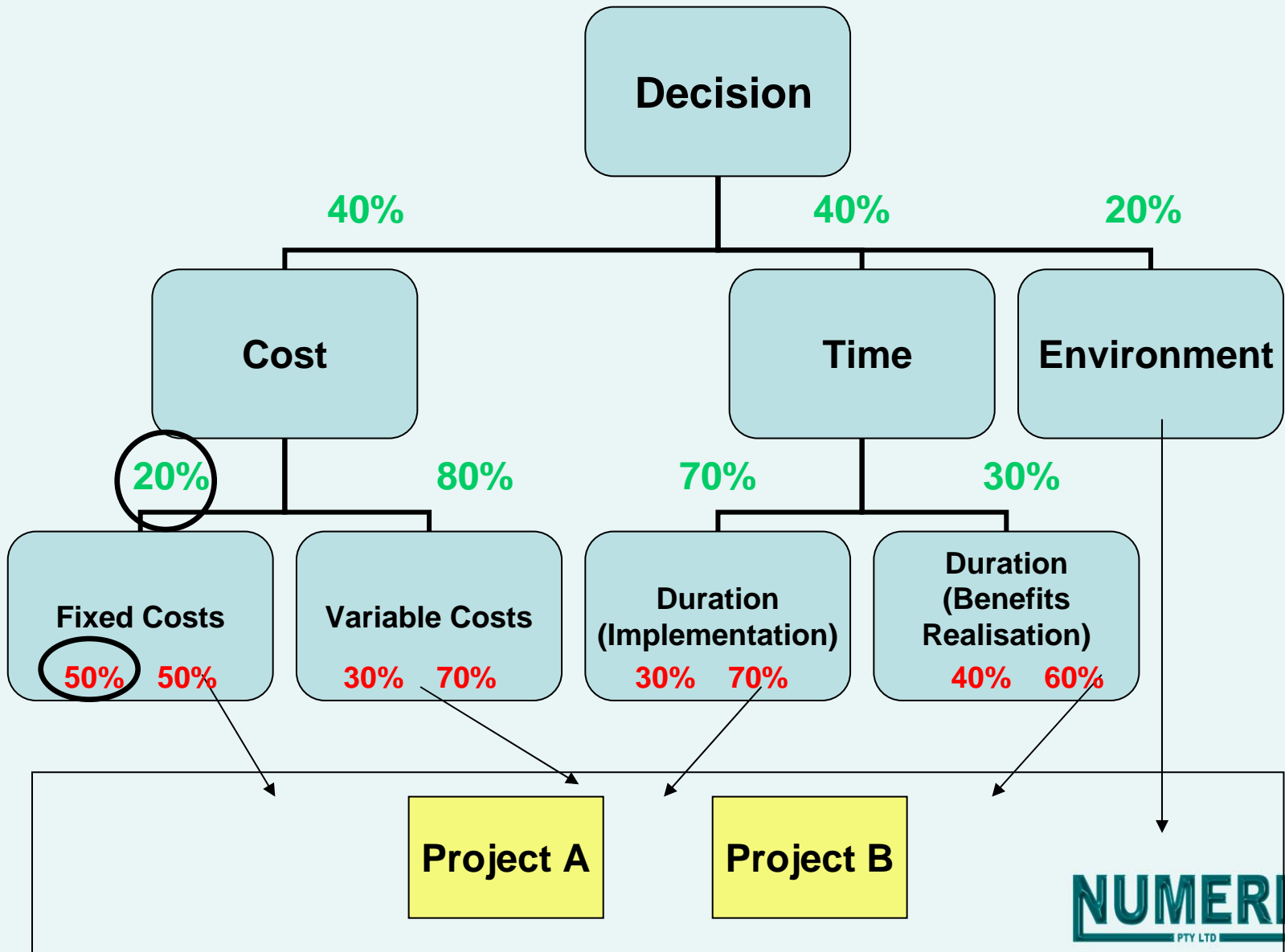
The Decision Hierarchy



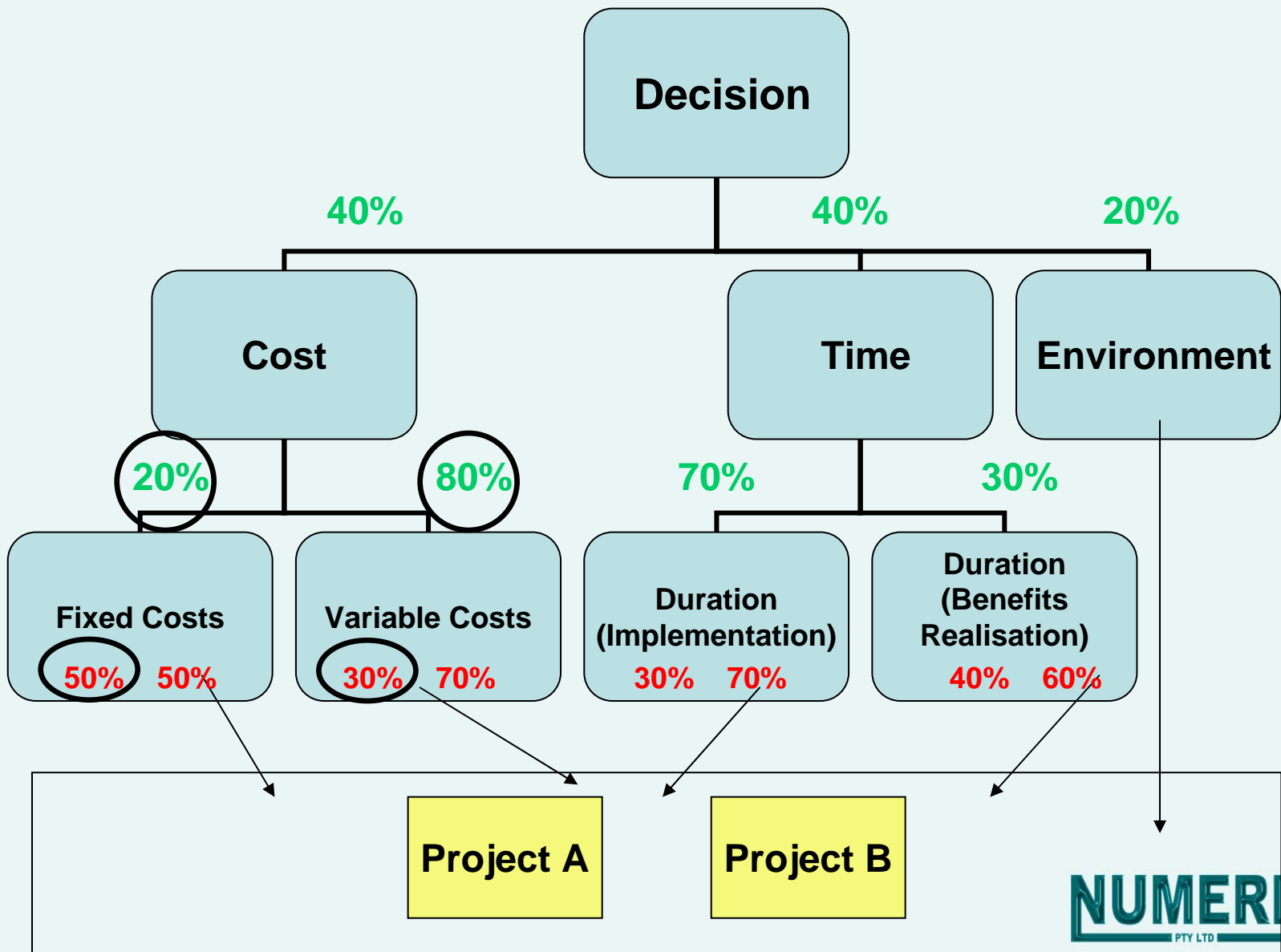
The Decision Hierarchy



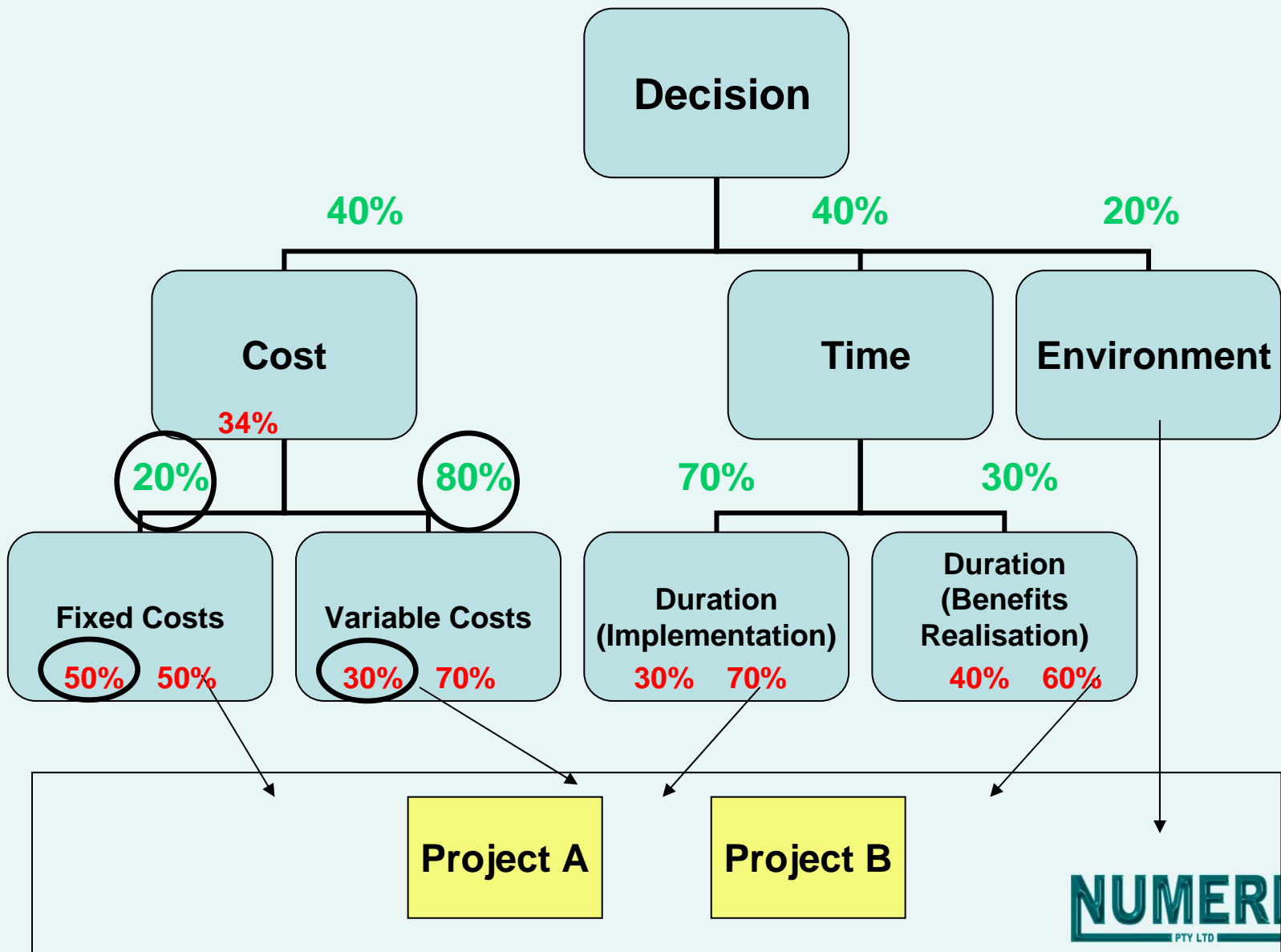
The Decision Hierarchy



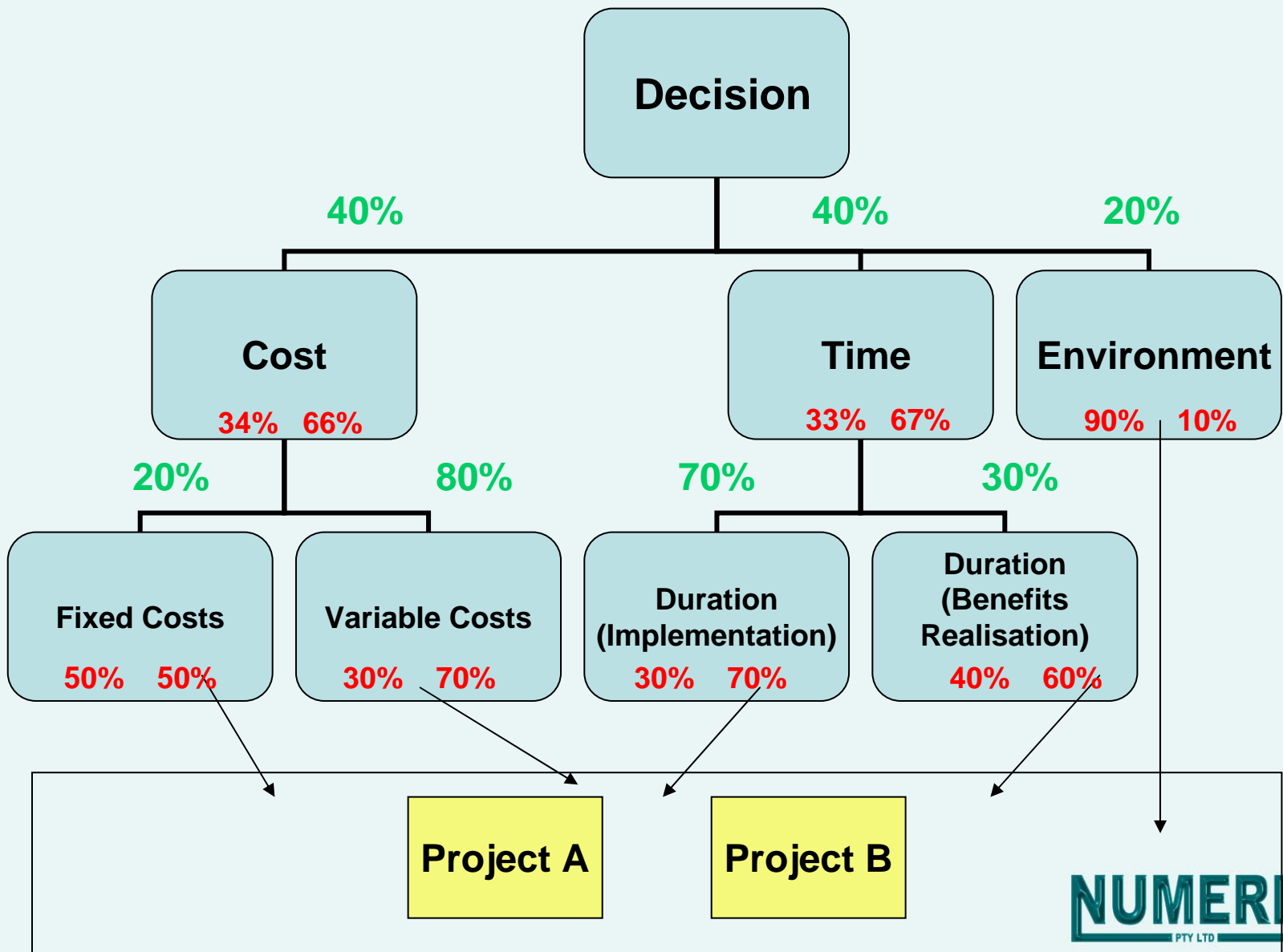
The Decision Hierarchy



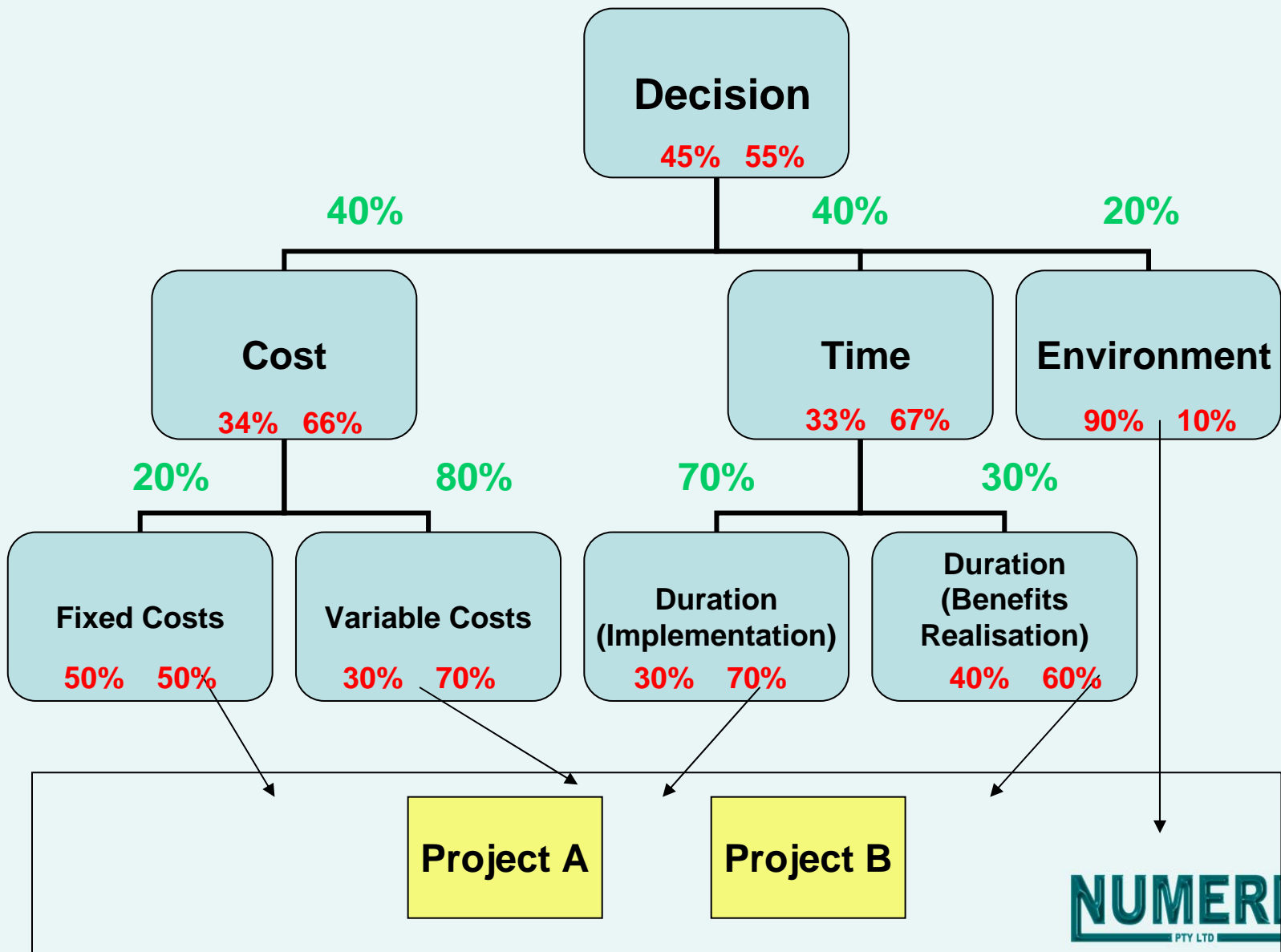
The Decision Hierarchy



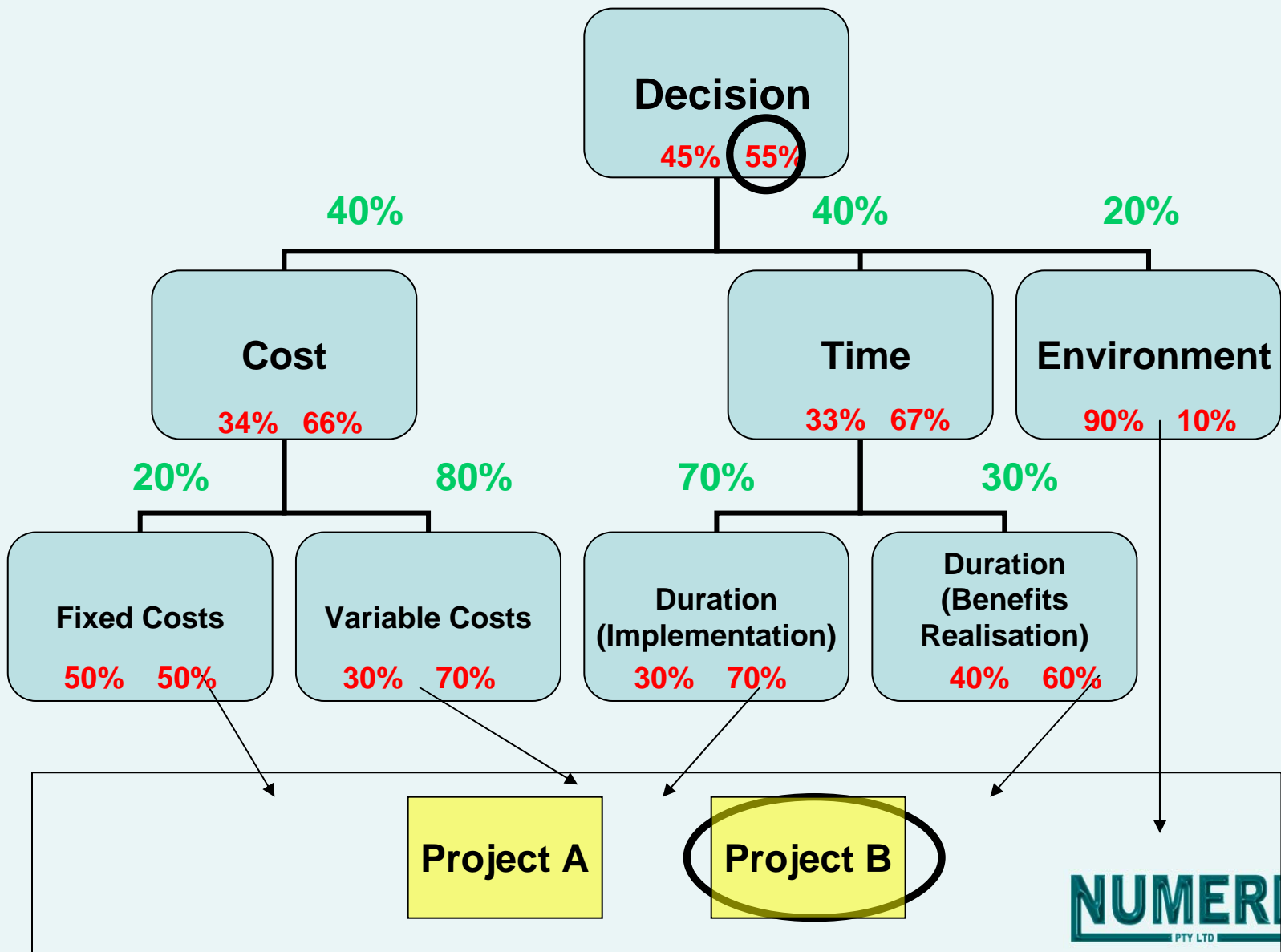
The Decision Hierarchy



The Decision Hierarchy



The Decision Hierarchy



			Option Preferences		
			1	2	
0	Final Decision		44.80	55.20	
1	Cost	40	34	66	calculated
2	Time	40	33	67	assessed
3	Environment	20	90	10	
1.1	Fixed Costs	20	50	50	
1.2	Variable Costs	80	30	70	
2.1	Implementation	70	30	70	
2.2	Benefits Realisation	30	40	60	

AHP Implementation in Excel

Strengths of AHP

1. Provides a formal structure for decision making
2. Results can confirm intuitive approach.
3. Results can refute intuitive approach – leading to re-examination of assumption and preferences.
4. Provides a consultative decision-making forum.
5. Promotes collaborative and distributed decision-making
6. Reflects and represents a range of opinions.
7. Provides a qualitative and quantitative analysis
8. Ensures consistency in application of preferences.
9. Provides documented record of decision approach assisting with corporate memory and knowledge capture.

Decision Results

• Project A	45%
• Project B	55%
	<hr/>
• Total	100%

Strategic Initiative Selection

List of Candidate Projects

- Costing and Invoice Integration
- Personnel Information System
- Business Plan Standardisation
- Quality Management Plan
- Risk Containment Plan
- Purchasing Process Rationalisation
- Warehouse Relocation
- Vehicle Registration System

Relative Strategic Values from AHP

- Costing and Invoice Integration 15%
- Personnel Information System 12%
- Business Plan Standardisation 5%
- Quality Management Plan 19%
- Risk Containment Plan 12%
- Purchasing Process Rationalisation 8%
- Warehouse Relocation 20%
- Vehicle Registration System 9%

Total

100%

Modified AHP and Project Selection

- Conventional AHP identifies the best single option from the candidate list.
- This approach uses AHP to identify the best option sub-set from the candidate list
-which satisfies some common set of constraints (budget, risk, effort, specialist skills.....)

Relative Strategic Values

• Costing and Invoice Integration	15%
• Personnel Information System	12%
• Business Plan Standardisation	5%
• Quality Management Plan	19%
• Risk Containment Plan	2%
• Purchasing Process Rationalisation	18%
• Warehouse Relocation	20%
• Vehicle Registration System	9%
<hr/>	
Total Available	100%

Relative Strategic Values

• Costing and Invoice Integration	15%
• Personnel Information System	12%
• Business Plan Standardisation	5%
• Quality Management Plan	19%
• Risk Containment Plan	2%
• Purchasing Process Rationalisation	18%
• Warehouse Relocation	20%
• Vehicle Registration System	9%
<hr/>	
Total Available	100%
Total Achievable	60%

Constrained Strategic Value Optimisation

The Problem:

Select those projects which maximise strategic value as defined by AHP

Subject to.....

Constraints (e.g. Cost, Work hours, skills, Risk)

The Process:

Identify candidate projects.
Develop and weight criteria and sub-criteria.
Evaluate projects against sub-criteria
Provide early cost estimate with uncertainty interval.
Calculate AHP
Identify Total Budget Available for all projects

Projects	A	B	C	D	E	F	G	H	I	J
Residual Risk	38	145	57	39	94	100	65	174	54	175
Selection	1	1	1	0	1	0	1	1	0	0
Randomised Project Cost	3.2	8.5	2	11	3	6	2	5	5.8	8.4
Lower Uncertainty Factor	0	0	0	0	0	0	0	0	0	0
Upper Uncertainty Factor	0	0	0	0	0	0	0	0	0	0
Specified Project Cost	3.2	8.5	2	11	3	6	2	5	5.8	8.4
Risk Cost Uncertainty	40	40	40	40	40	40	40	40	40	40
Risk Reduction Costs	0.45	1.74	0.66	0.57	1.56	1.32	0.75	2.13	0.6	1.89
Forced Selection	0	0	0	0	0	0	0	0	0	0

 Selected
 Non Selected

Initiate

Run

Final AHP Vector	Weights	13.38	10.82	8.9	16.7	14.1	6.22	7.98	10.58	5.1	6.22
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100

1 Technological Feasibility	40	16.75	6.75	14.75	6.75	13.25	3.05	8.95	13.25	3.05	13.45
2 Time Horizon	20	21	17	5	12	6	5	18	6.8	5.8	3.4
3 Resourcing	40	6.2	11.8	5	29	19	10	2	9.8	6.8	0.4

100
100
100

1.1 Software	65	15	5	20	5	15	2	3	15	2	18
1.2 Hardware	35	20	10	5	10	10	5	20	10	5	5

100
100

2.1 Short	40	20	10	5	10	10	5	20	10	5	5
2.2 Medium	40	30	30	5	5	0	5	20	2	2	1
2.3 Long	20	5	5	5	30	10	5	10	10	15	5

100
100
100

3.1 Contract Labour	40	5	10	5	35	10	25	5	2	2	1
3.2 Employee focus	60	7	13	5	25	25	0	0	15	10	0

100
100

Proposed Value 0.6576
Proposed Cost 23.7
Total Cost 25
Proposed Risk 573
Total Risk 941

AHP Implementation in Excel

Back

Strategic Values and Initial Cost Estimates

1.	Project 1	(37%)	500K
2.	Project 2	(29%)	700K
3.	Project 3	(14%)	300K
4.	Project 4	(20%)	200K

100%

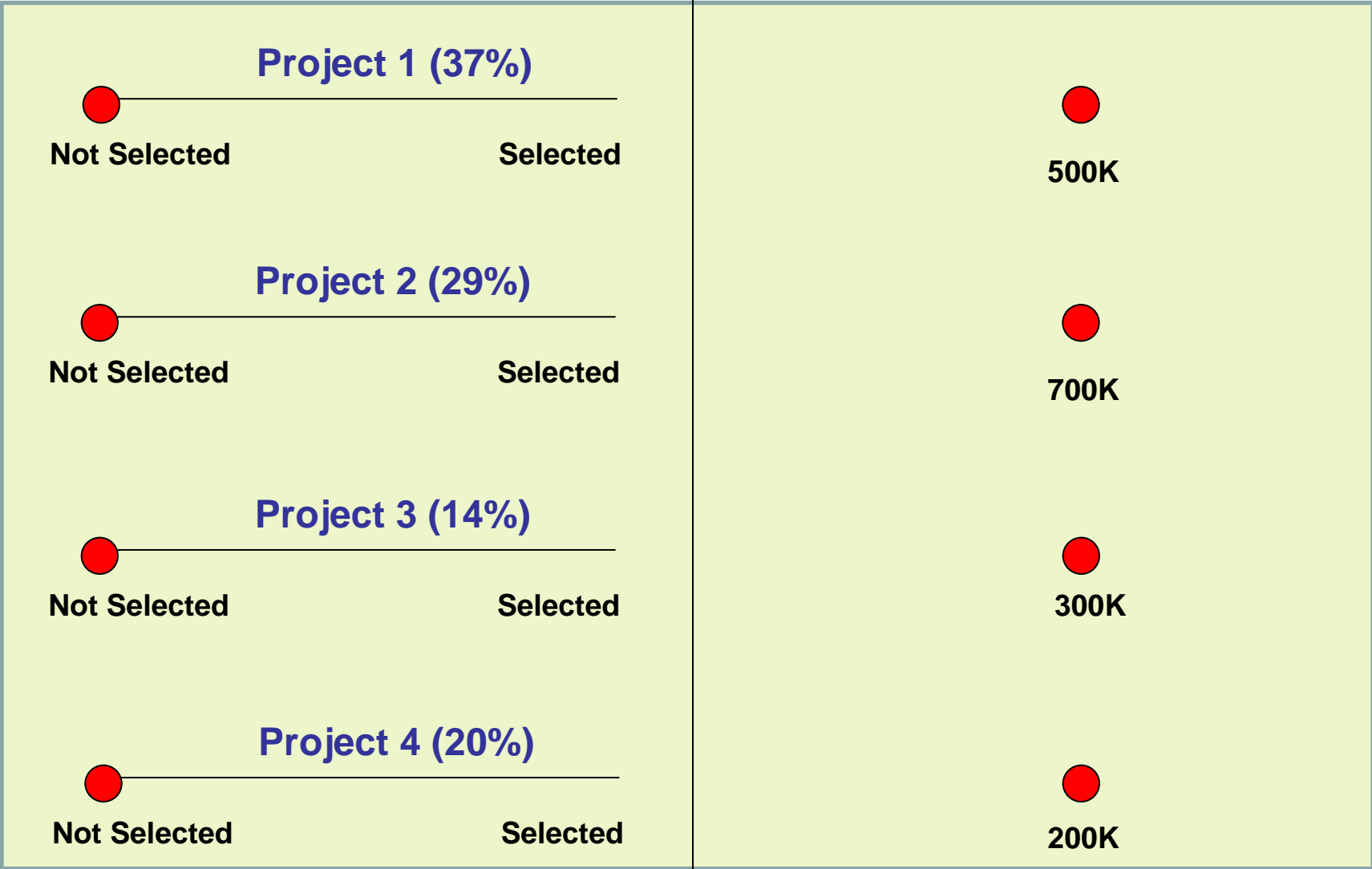
1700K

- **Identify candidate projects.**
- **Develop and weight criteria and sub-criteria.**
- **Evaluate projects against sub-criteria**
- **Provide early cost estimate with uncertainty interval.**
- **Calculate AHP**
- **Identify Total Budget Available for all projects**



**Maximise value from top level
AHP subject to shared cost
constraints**

Project Selection Under Constraints



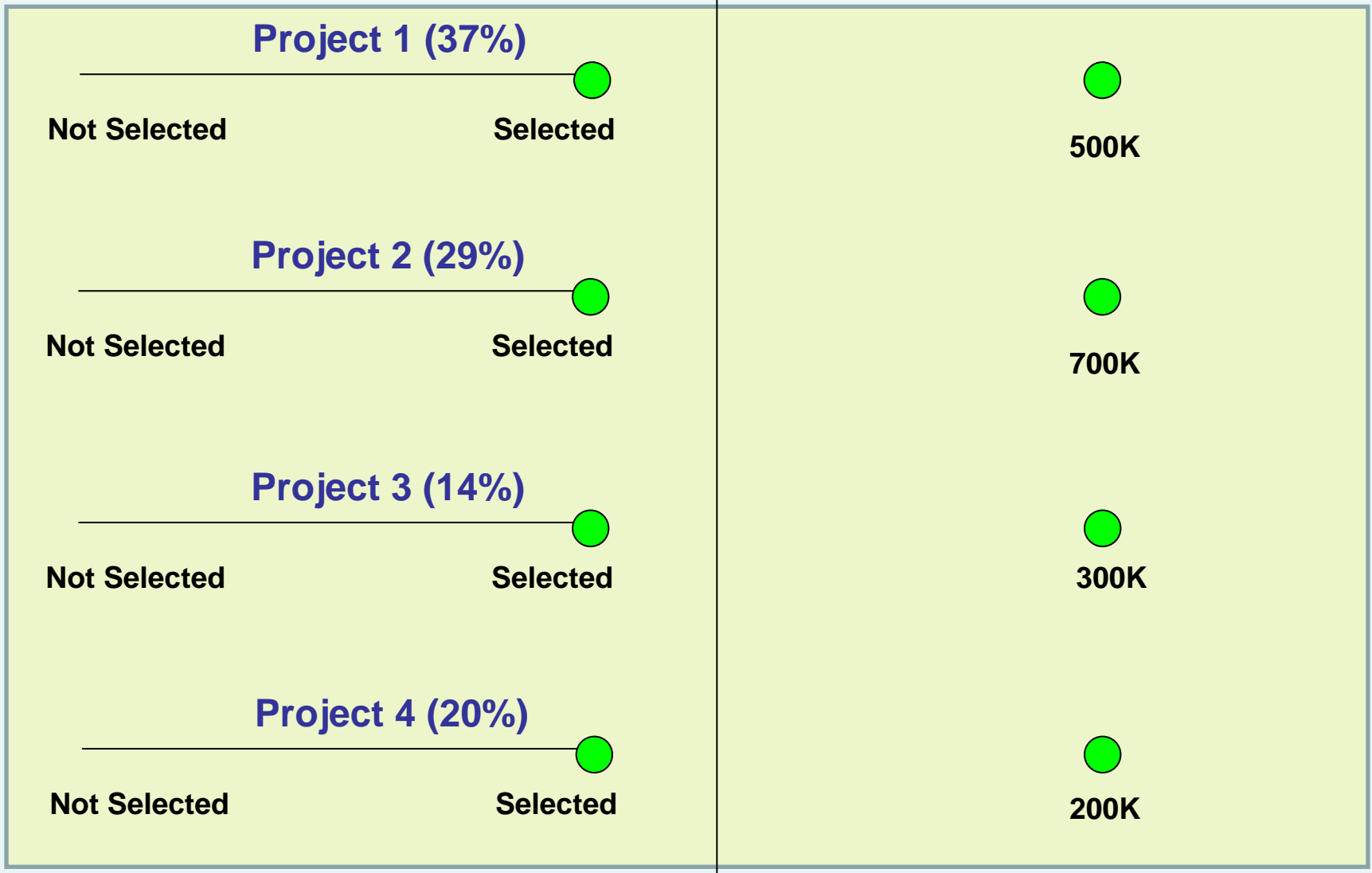
Total Value: 0%

Total Budget: 0K

Total Forecast: 0K



Project Selection Under Constraints

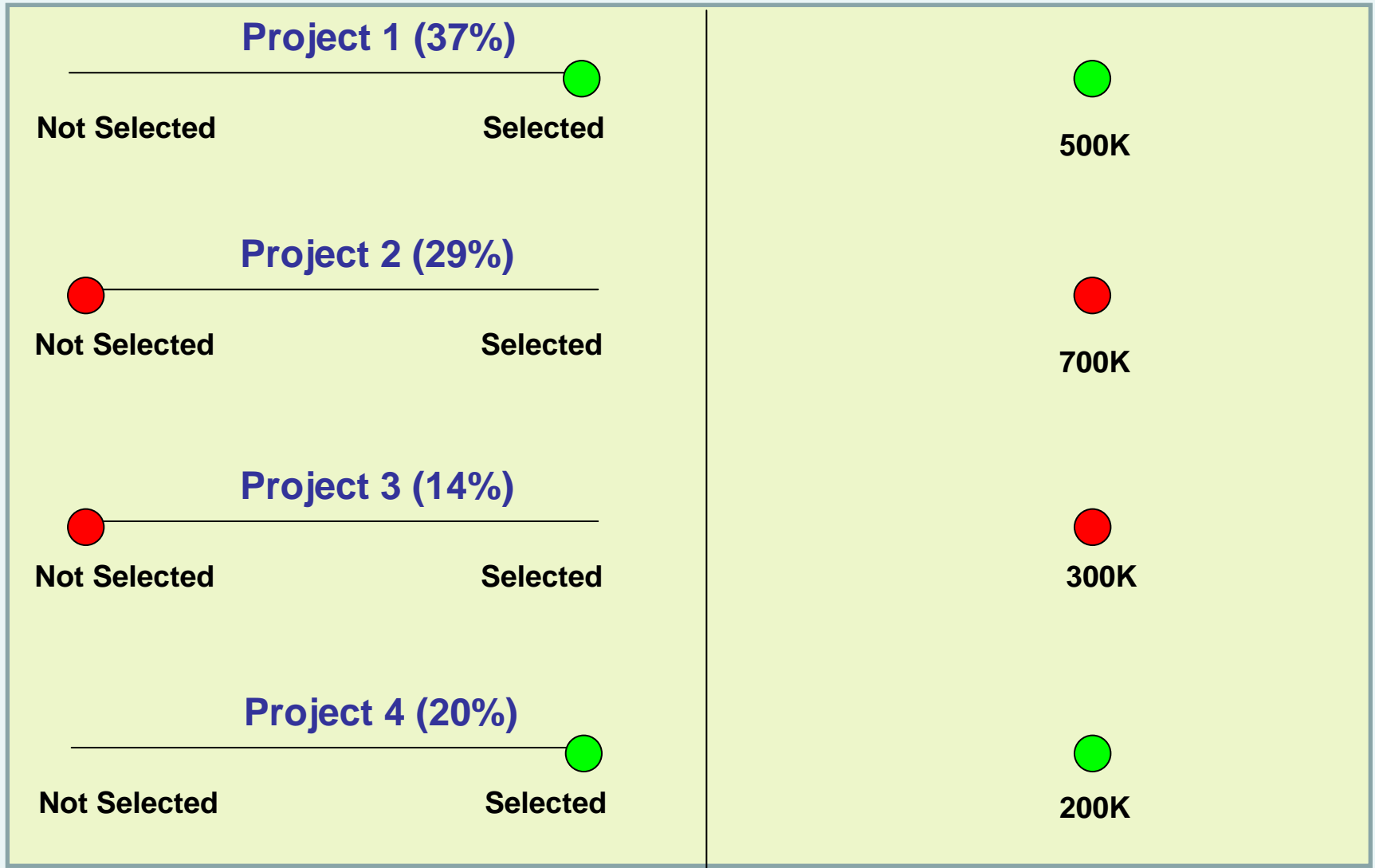


Total Value: 100%

Total Budget: 900K

Total Forecast: 1700K

Project Selection Under Constraints

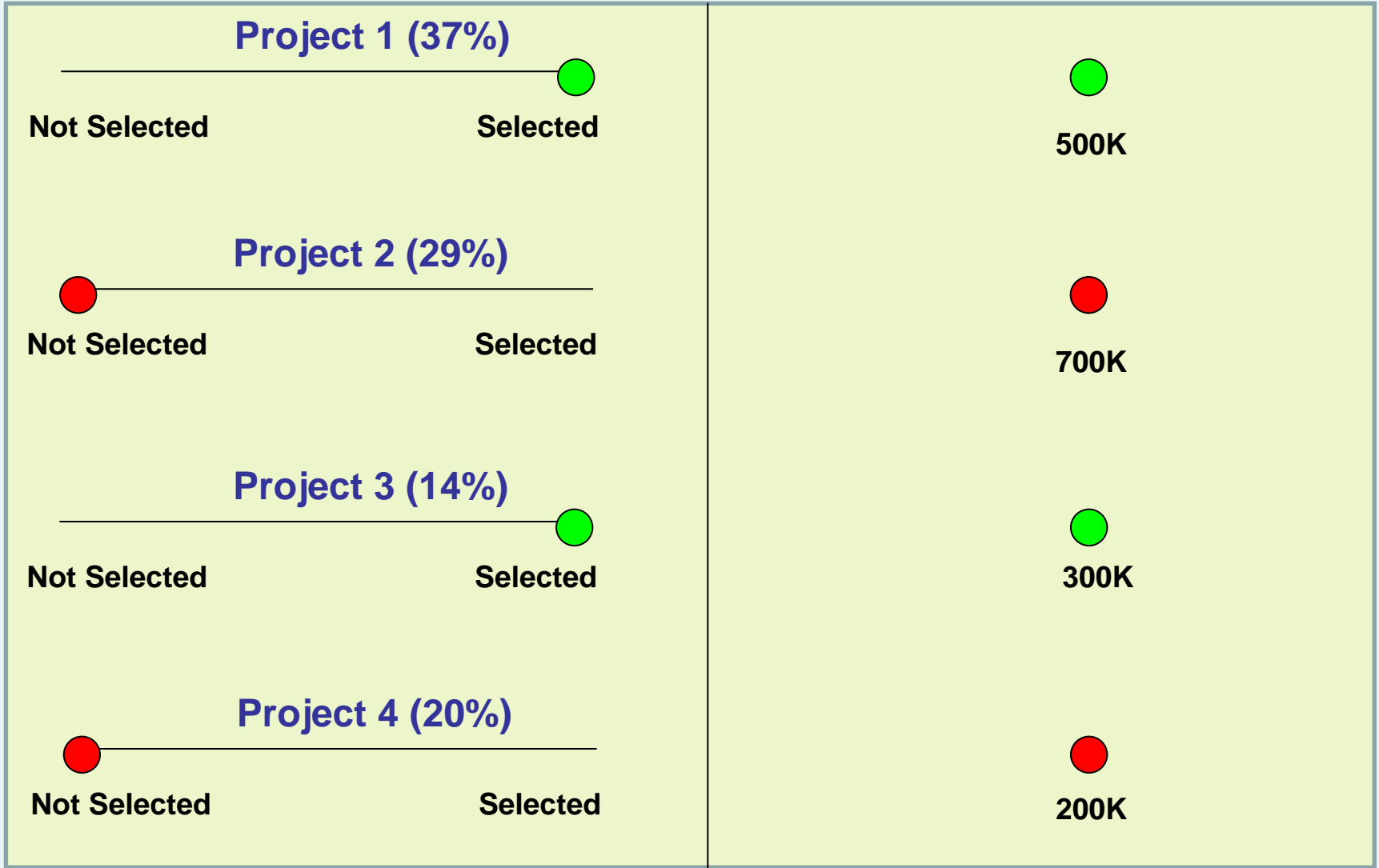


Total Value: 47%

Total Budget: 700K

Total Forecast: 700K

Project Selection Under Constraints

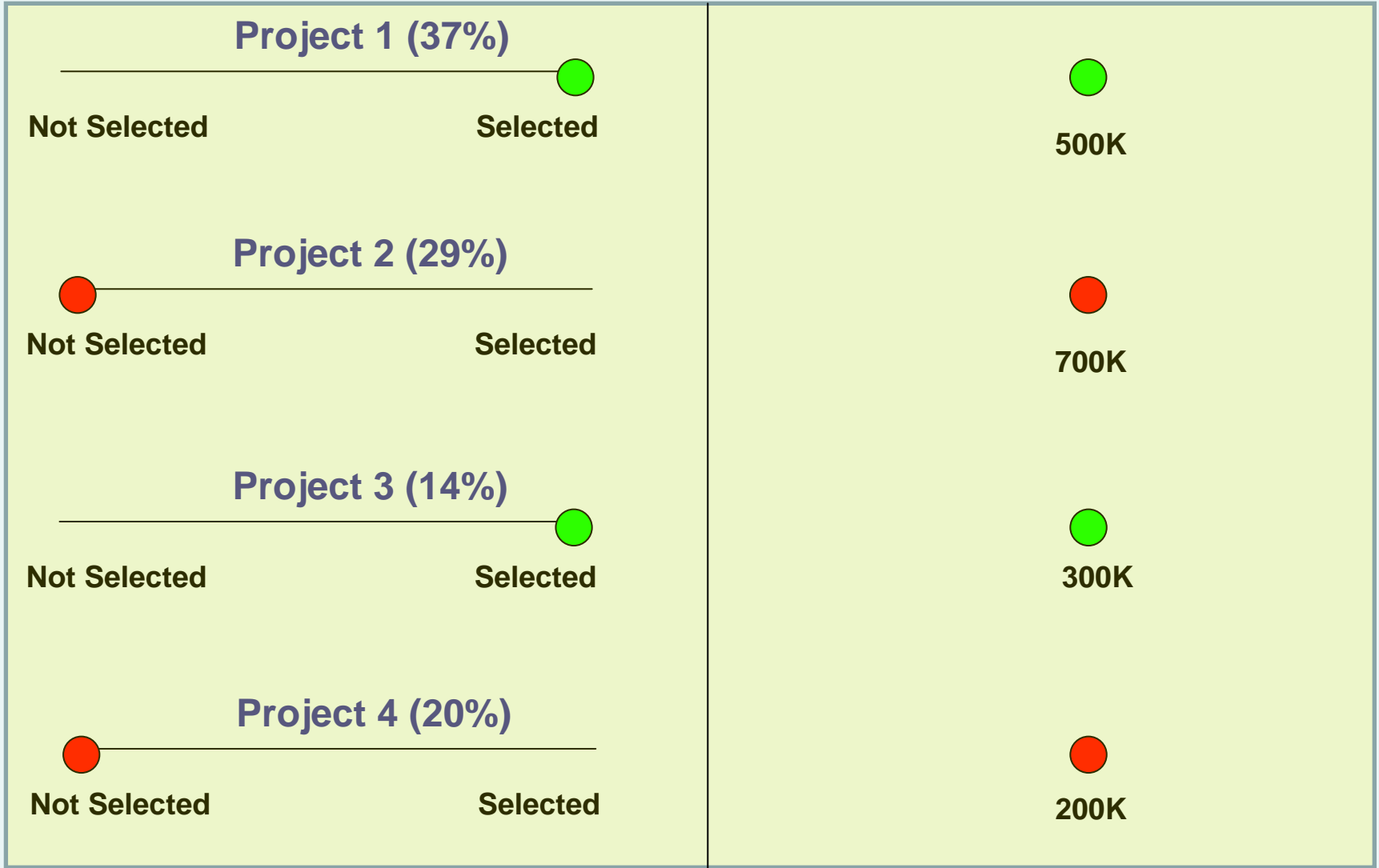


Total Value: 51%

Total Budget: 800K

Total Forecast: 800K

Project Selection Under Constraints

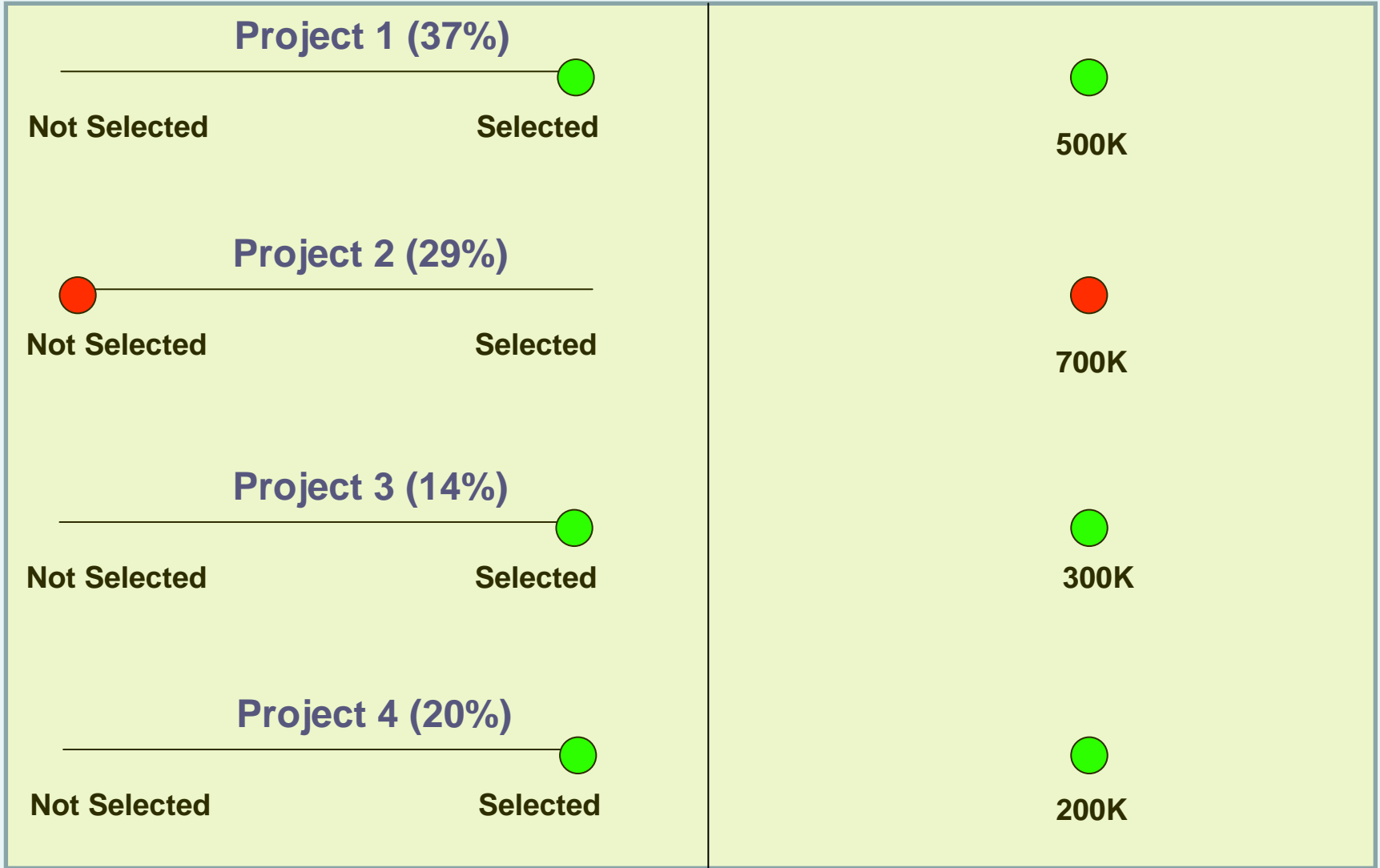


Total Value: 51%

Total Budget: 900K

Total Forecast: 800K

Project Selection Under Constraints



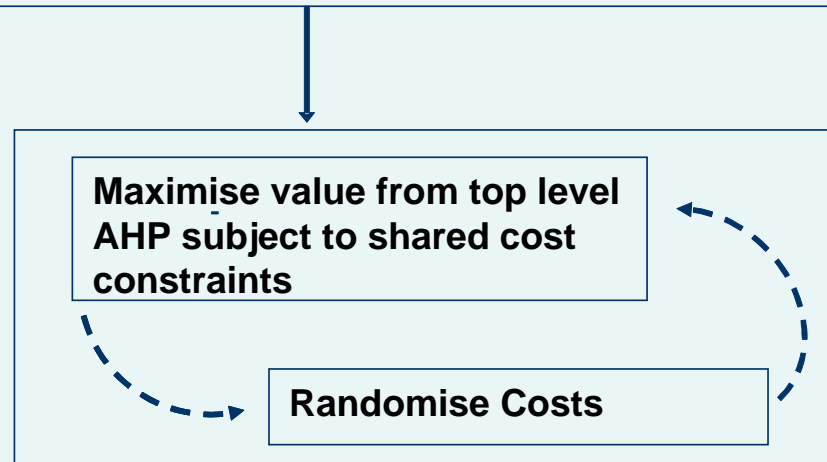
Total Value: 71%

Total Budget: 1000K

Total Forecast: 1000K

Introducing Uncertainty

- Identify candidate projects.
- Develop and weight criteria and sub-criteria.
- Evaluate projects against sub criteria
- Provide early cost estimate with uncertainty interval.
- Calculate AHP
- Identify Total Budget Available for all projects



Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K



Total Value: 51%

Total Budget: 900K

Total Forecast: 800K

Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K



Total Value: 71%

Total Budget: 900K

Total Forecast: 900K

Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K



Total Value: 51%

Total Budget: 900K

Total Forecast: 800K

Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K



Total Value: 51%

Total Budget: 900K

Total Forecast: 800K

Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K



Total Value: 71%

Total Budget: 900K

Total Forecast: 800K

Project Selection Under Randomised Constraints

Project 1 (37%)

Not Selected

Selected



Project 2 (29%)

Not Selected

Selected



Project 3 (14%)

Not Selected

Selected



Project 4 (20%)

Not Selected

Selected



Cost Uncertainty

400K

500K

600K



Cost Uncertainty

500K

700K

900K



Cost Uncertainty

100K

300K

500K



Cost Uncertainty

100K

200K

300K

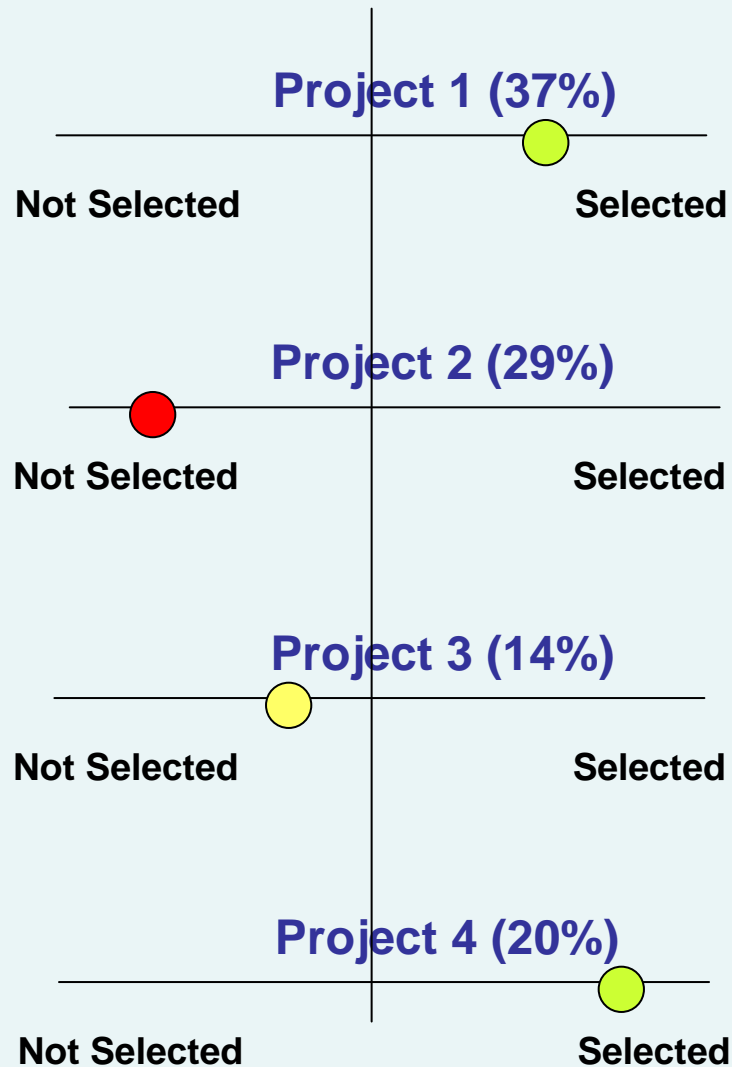


Total Value: 66%

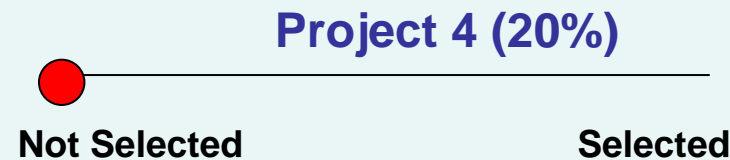
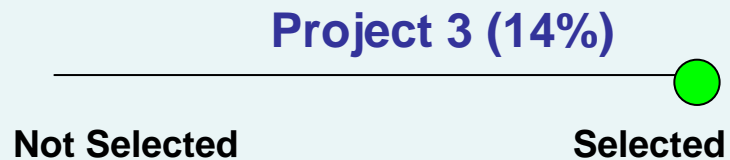
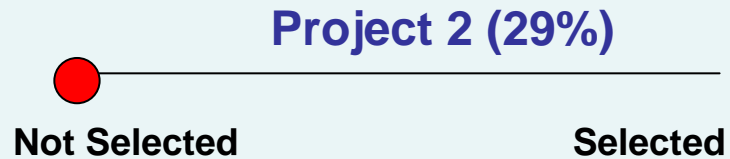
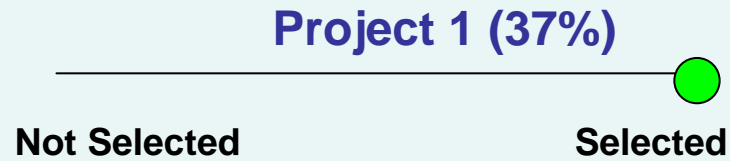
Total Budget: 900K

Total Forecast: 900K

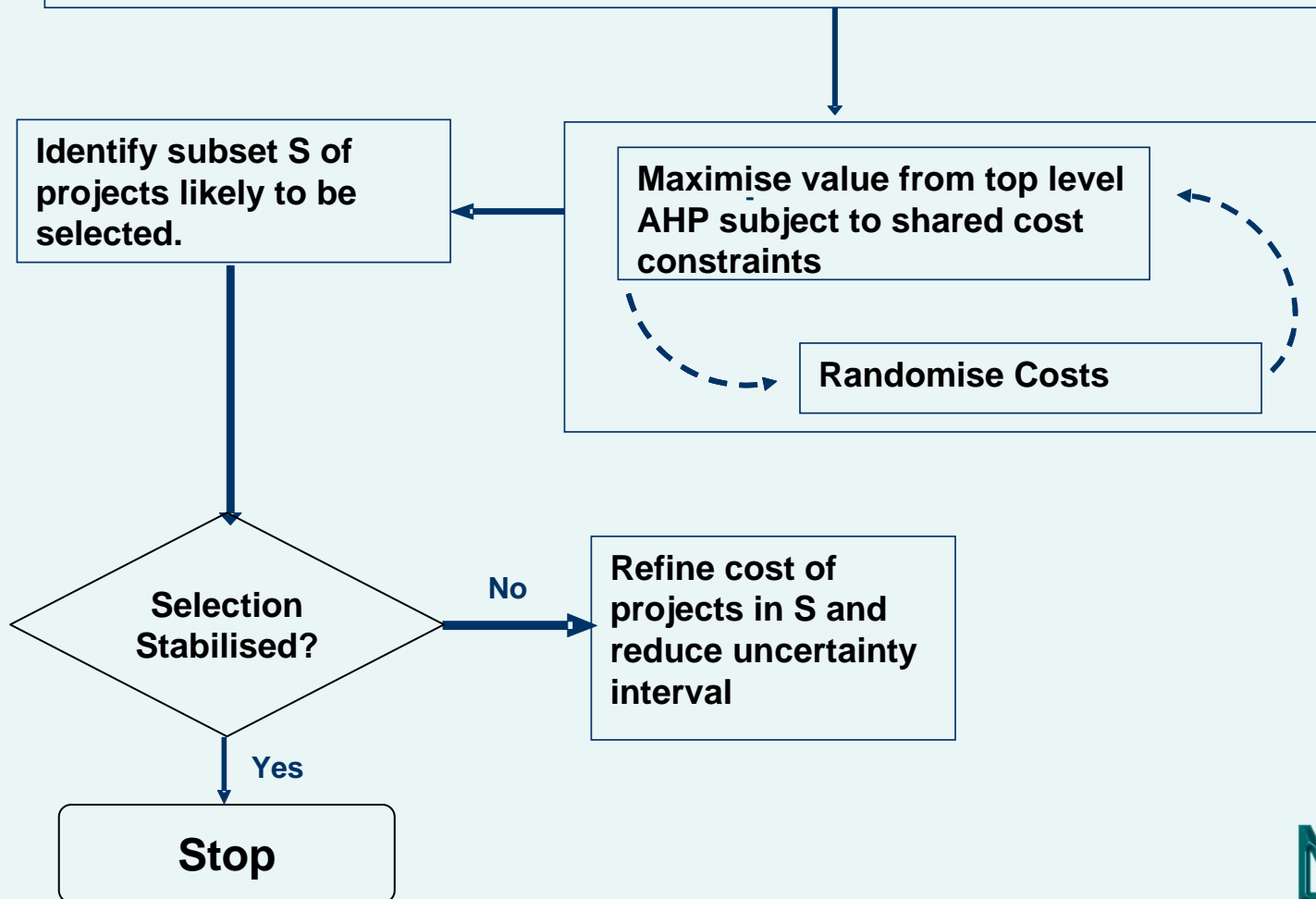
Current Selection Probabilities: 'Fuzzy' Results (based on average of Simulation Results)



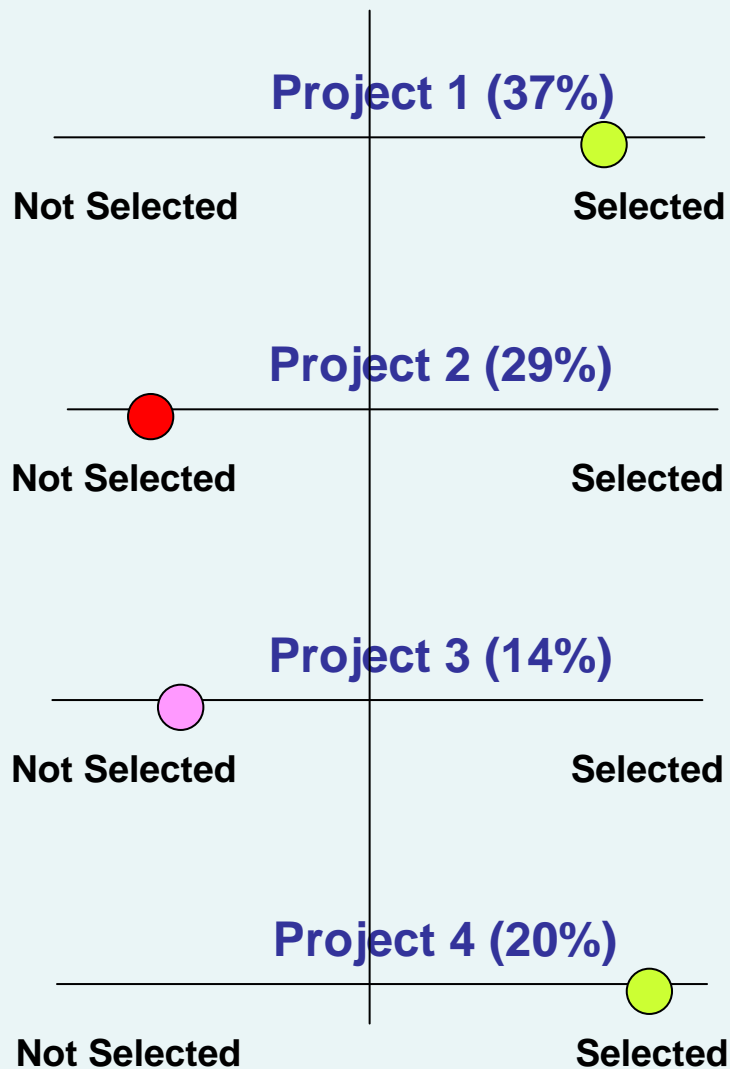
Possible Eventual Selection Configuration



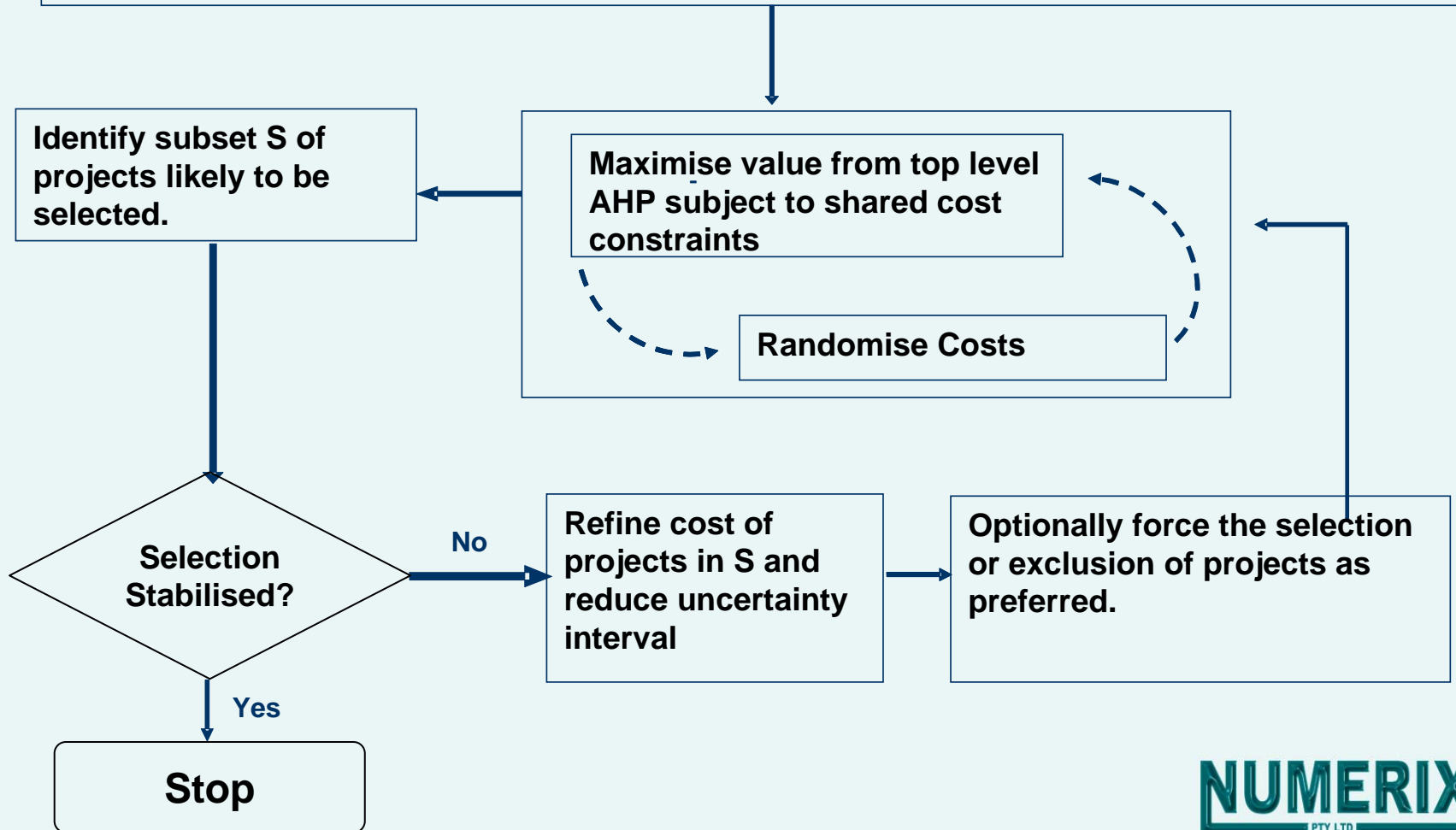
- Identify candidate projects.
- Develop and weight criteria and sub-criteria.
- Evaluate projects against sub criteria
- Provide early cost estimate with uncertainty interval.
- Calculate AHP
- Identify Total Budget Available for all projects



Current Selection Probabilities: 'Fuzzy' Results (based on average of Simulation Results)



- Identify candidate projects.
- Develop and weight criteria and sub-criteria.
- Evaluate projects against sub criteria
- Provide early cost estimate with uncertainty interval.
- Calculate AHP
- Identify Total Budget Available for all projects



Project Interdependencies

$$X_b = 1$$

Option b must be selected

$$X_b = 0$$

Option b must not be selected

$$X_b + X_c = 1$$

One and only one of either option b or c must be selected.

$$X_b + X_c \leq 1$$

Options b and c should not be selected together.

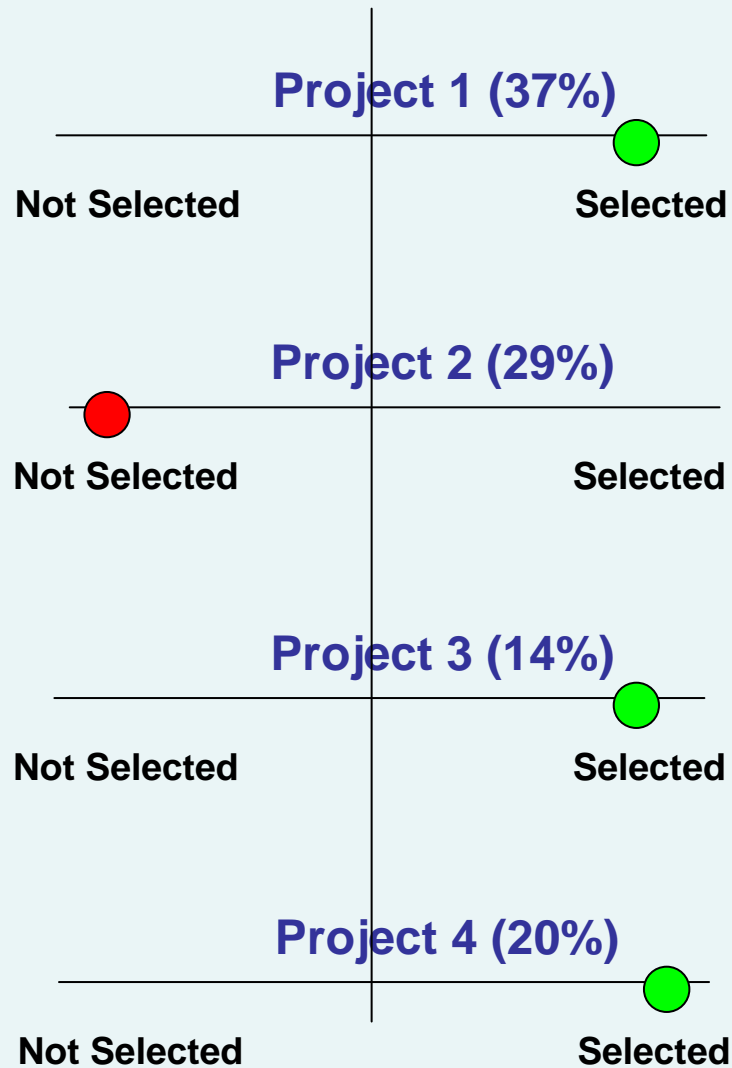
$$X_b \leq X_c$$

Option b implies the selection of option c

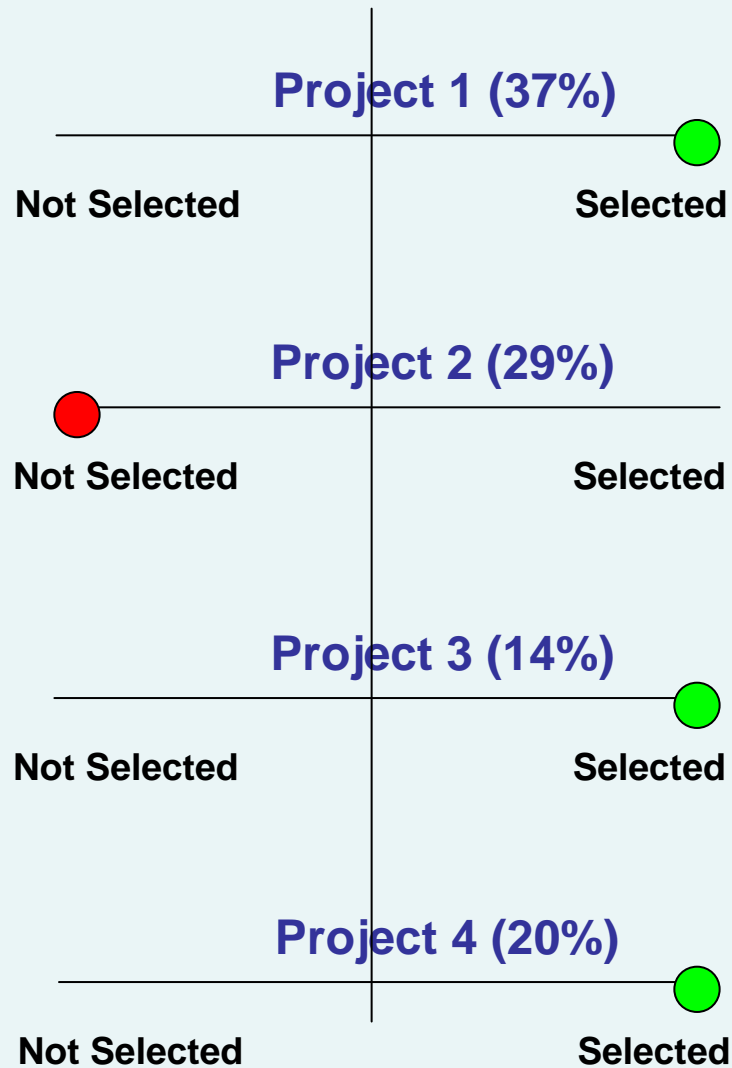
$$X_b = X_c$$

Either both or neither of options b and c must be selected

Fuzzy Final Results

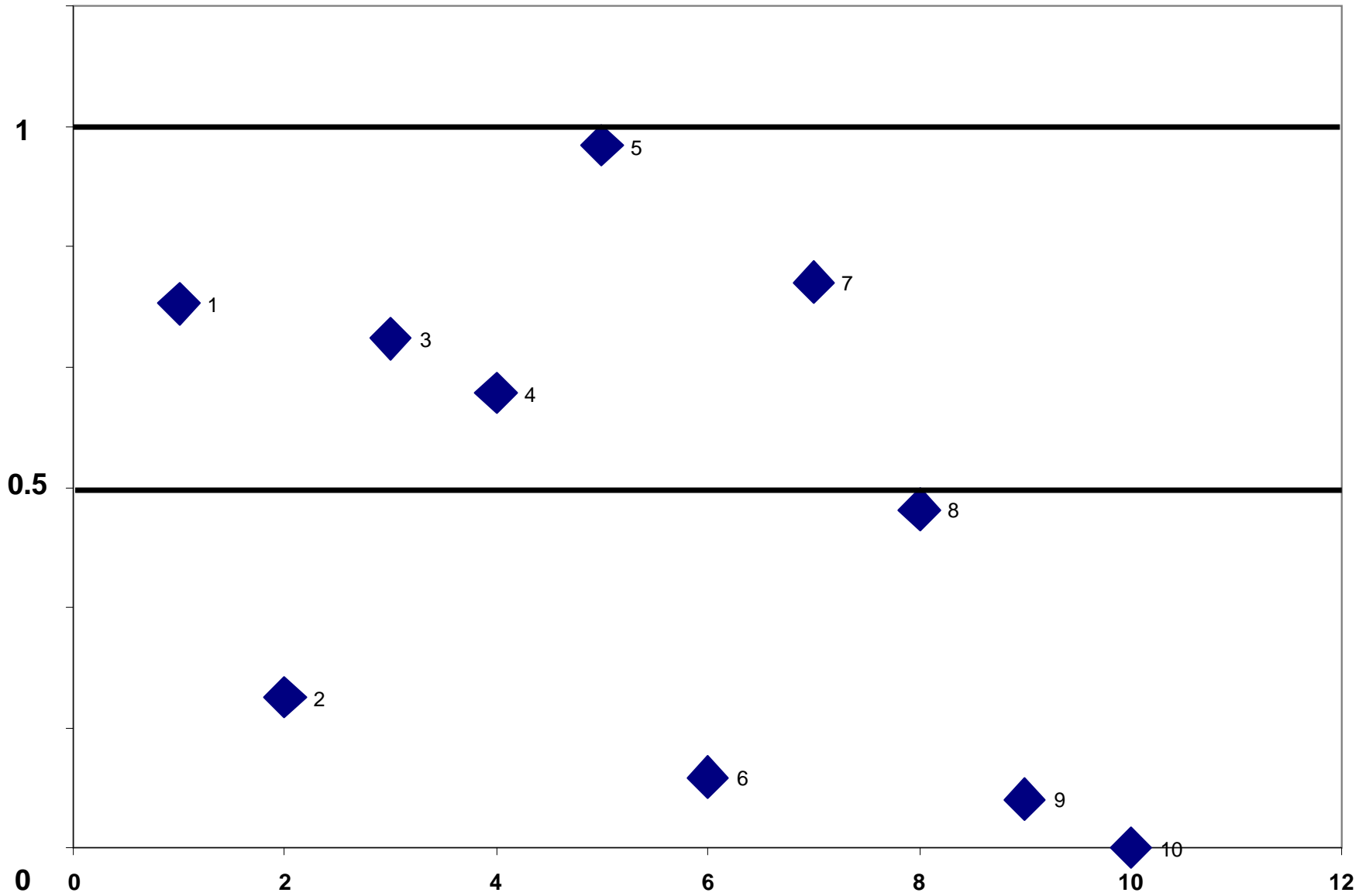


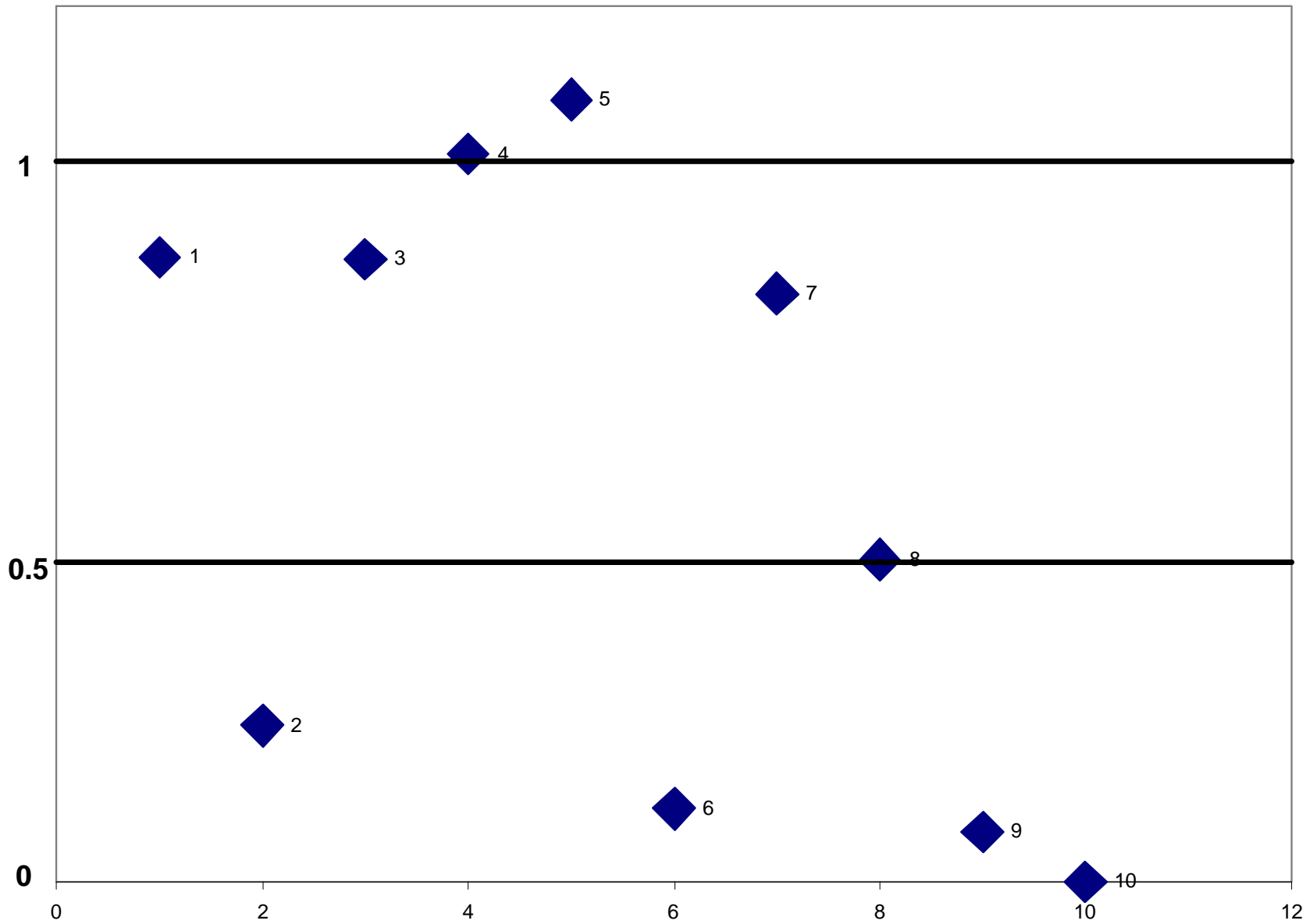
Anticipated Final Results



Relative Strategic Values

• Costing and Invoice Integration	15%
• Personnel Information System	12%
• Business Plan Standardisation	5%
• Quality Management Plan	19%
• Risk Containment Plan	2%
• Purchasing Process Rationalisation	18%
• Warehouse Relocation	20%
• Vehicle Registration System	9%
<hr/>	
Total Available	100%
Total Achievable	60%





Practical Considerations

- **Appoint Program Manager**
- **Let Initial AHP identify short list of projects**
 - This can be implemented in Excel. See [here](#)
- **Appoint Project (sub-project) [managers](#)**
- **Coach all in basic philosophy of the approach**
- **Request initial Cost Estimates from all PMs (0.25C,1.75C).**
 - This can result from a shallow (say level 2 WBS)
- **Perform initial randomisation and project identification iteration.**
 - This can be done in Excel using the Solver Add-in feature.
- **Make initial 'fuzzy' project cut**

Practical Considerations

- **Tentatively suspend currently non-selected projects and inform relevant PMs of this status**
- **Request more detailed cost estimate from selected project PMs**
 - Perhaps 3-4 level WBS (0.4C,1.4C)
- **Alert for cross-over leverage**
- **Establish copies of revised schedules/estimates**

Summary and Conclusions

- Process is simple and optimal
- Maximises value within constraints and also minimises effort required on poor candidates
- Minimal Microsoft Excel skills required
- Wide applicability
- Particularly useful for internal or organisational projects
- Particularly well suited to strategic planning

Thank You!

Projects	A	B	C	D	E	F	G	H	I	J
Residual Risk	38	145	57	39	94	100	65	174	54	175
Selection	1	1	1	0	1	0	1	1	0	0
Randomised Project Cost	3.2	8.5	2	11	3	6	2	5	5.8	8.4
Lower Uncertainty Factor	0	0	0	0	0	0	0	0	0	0
Upper Uncertainty Factor	0	0	0	0	0	0	0	0	0	0
Specified Project Cost	3.2	8.5	2	11	3	6	2	5	5.8	8.4
Risk Cost Uncertainty	40	40	40	40	40	40	40	40	40	40
Risk Reduction Costs	0.45	1.74	0.66	0.57	1.56	1.32	0.75	2.13	0.6	1.89
Forced Selection	0	0	0	0	0	0	0	0	0	0

 Selected
 Non Selected

Initiate

Run

Final AHP Vector	Weights	13.38	10.82	8.9	16.7	14.1	6.22	7.98	10.58	5.1	6.22
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100

1 Technological Feasibility	40	16.75	6.75	14.75	6.75	13.25	3.05	8.95	13.25	3.05	13.45
2 Time Horizon	20	21	17	5	12	6	5	18	6.8	5.8	3.4
3 Resourcing	40	6.2	11.8	5	29	19	10	2	9.8	6.8	0.4

100

100

100

1.1 Software	65	15	5	20	5	15	2	3	15	2	18
1.2 Hardware	35	20	10	5	10	10	5	20	10	5	5

✓

100

✓

100

2.1 Short	40	20	10	5	10	10	5	20	10	5	5
2.2 Medium	40	30	30	5	5	0	5	20	2	2	1
2.3 Long	20	5	5	5	30	10	5	10	10	15	5

✓

100

✓

100

✓

100

3.1 Contract Labour	40	5	10	5	35	10	25	5	2	2	1
3.2 Employee focus	60	7	13	5	25	25	0	0	15	10	0

✓

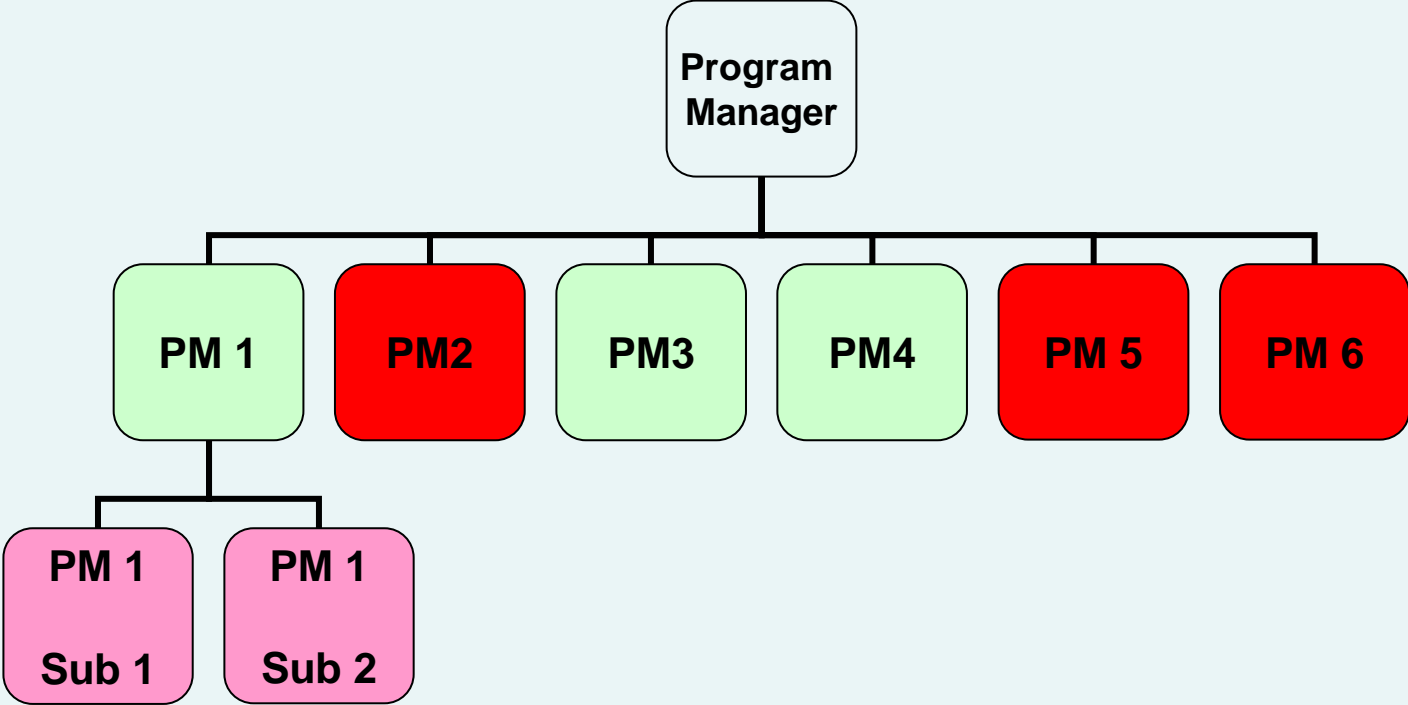
100

✓

100

Proposed Value 0.6576
Proposed Cost 23.7
Total Cost 25
Proposed Risk 573
Total Risk 941

Project Activity Status



Currently Not Selected



Currently Selected

Back