AIMS 2014, Brno, Czech Republic, June 30, 2014

TrAdeCIS: Trade-off-based Adoption Methodology for Cloud-based Infrastructures and Services

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Motivation/Problem
Methodology Outline
Illustration
Summary

CSG
Communication Systems Group

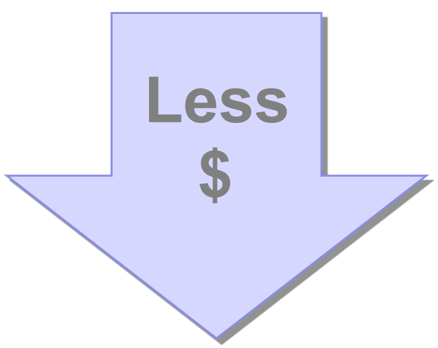
ifi

Motivation

? Which to select

amazon webservices™

rackspace® HOSTING



energy
Money Isn't All You're Saving

CloudProvider

Motivation

- Adoption of cloud-based solutions for IT requirements is based on:
  - Technical factors, e.g., availability, response time
  - Business oriented objectives, e.g., cost reduction, return of investment
- Decision of adoption is difficult:
  - Multiple selection criteria with different priority
  - Presence of more than one alternative solutions
- Gaps to be filled:
  - Methodology for deciding best available solution
  - Quantitative validation of decision made

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Trade-off-based Adoption Methodology for Cloud-based Infrastructures and Services

Organization demands Cloud-based Services Options

Optimal selection!

TrAdeCIS

Problem Statement

- To design a adoption methodology, that
  - Identifies relevant factors for evaluating alternative solutions
  - Ranks alternative solutions based on
    - Technical factors and business objectives
  - Establishes a trade-off-based decision
    - As relevant factors have different priority
- To establish a trade-off-based decision
  - Difficult to establish a relation between the returns of the decision made and priorities of the selecting criteria

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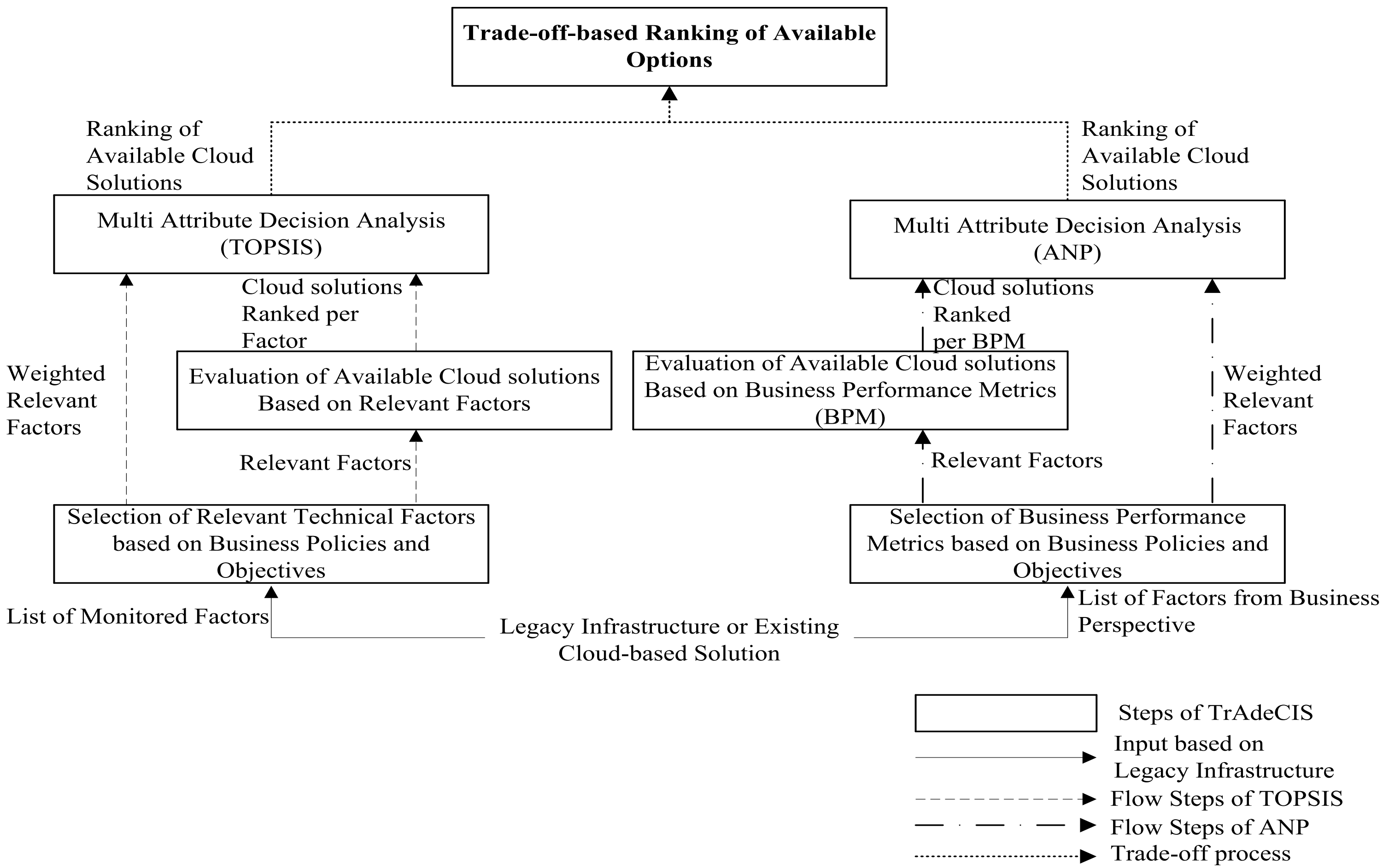
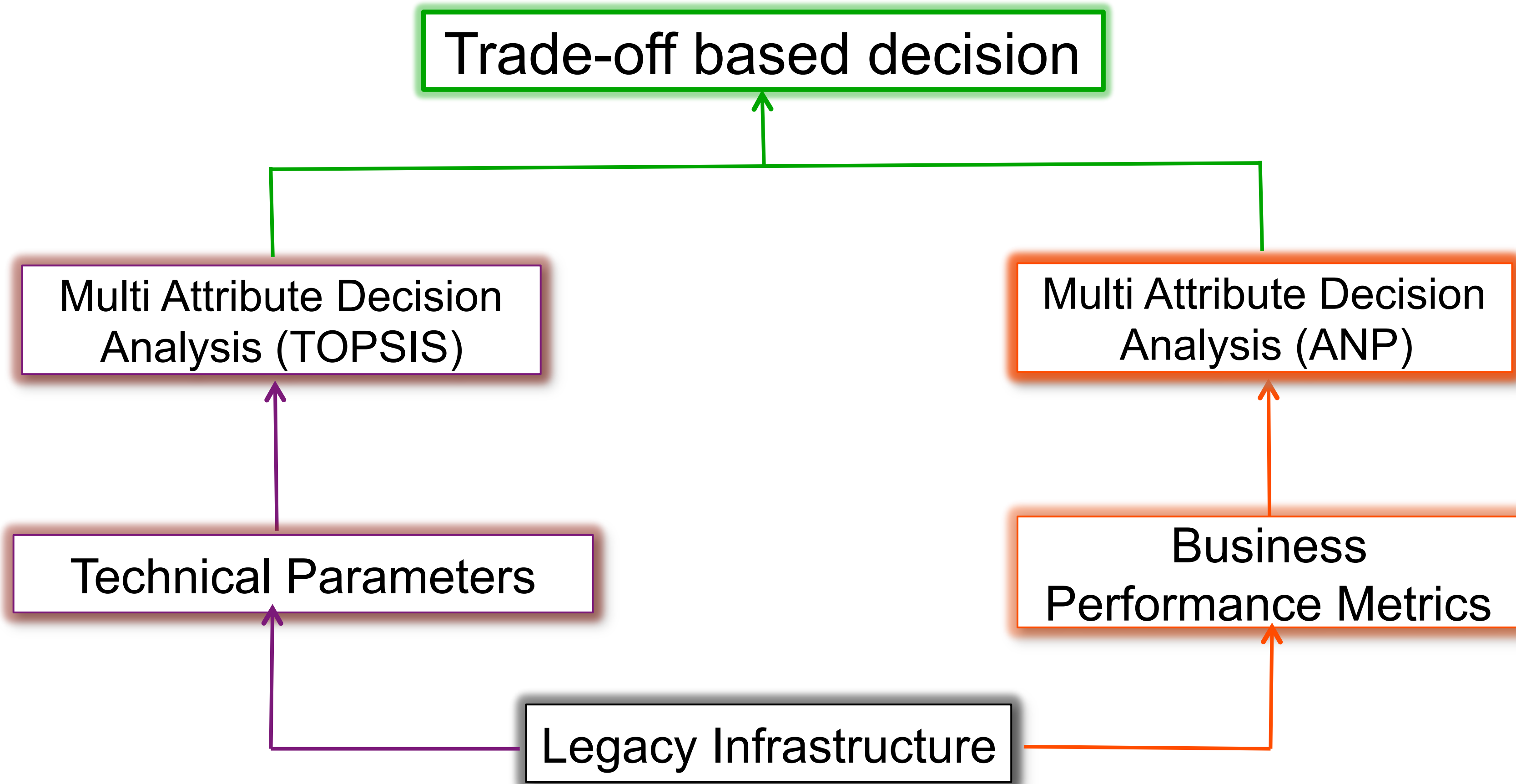


TOPSIS: Technique for Order of Preference by Similarity to Ideal Solution

ANP: Analytical Network Process

TrAdeCIS



TOPSIS: **T**echnique for **O**rder **P**reference by **S**imilarity to **I**deal **S**olution
ANP: **A**nalytic **N**etwork **P**rocess

Survey Based Illustration

- Survey done with 10 organizations
  - Plans to or have adopted cloud-based solutions for IT requirements
  - Follow ad-hoc methods for making a decision
  - Quantitative approach is not available
- Illustrating the methodology with a use-case
  - Health insurance, small-sized company
  - Plans to adopt cloud-based services for fulfilling infrastructure requirements

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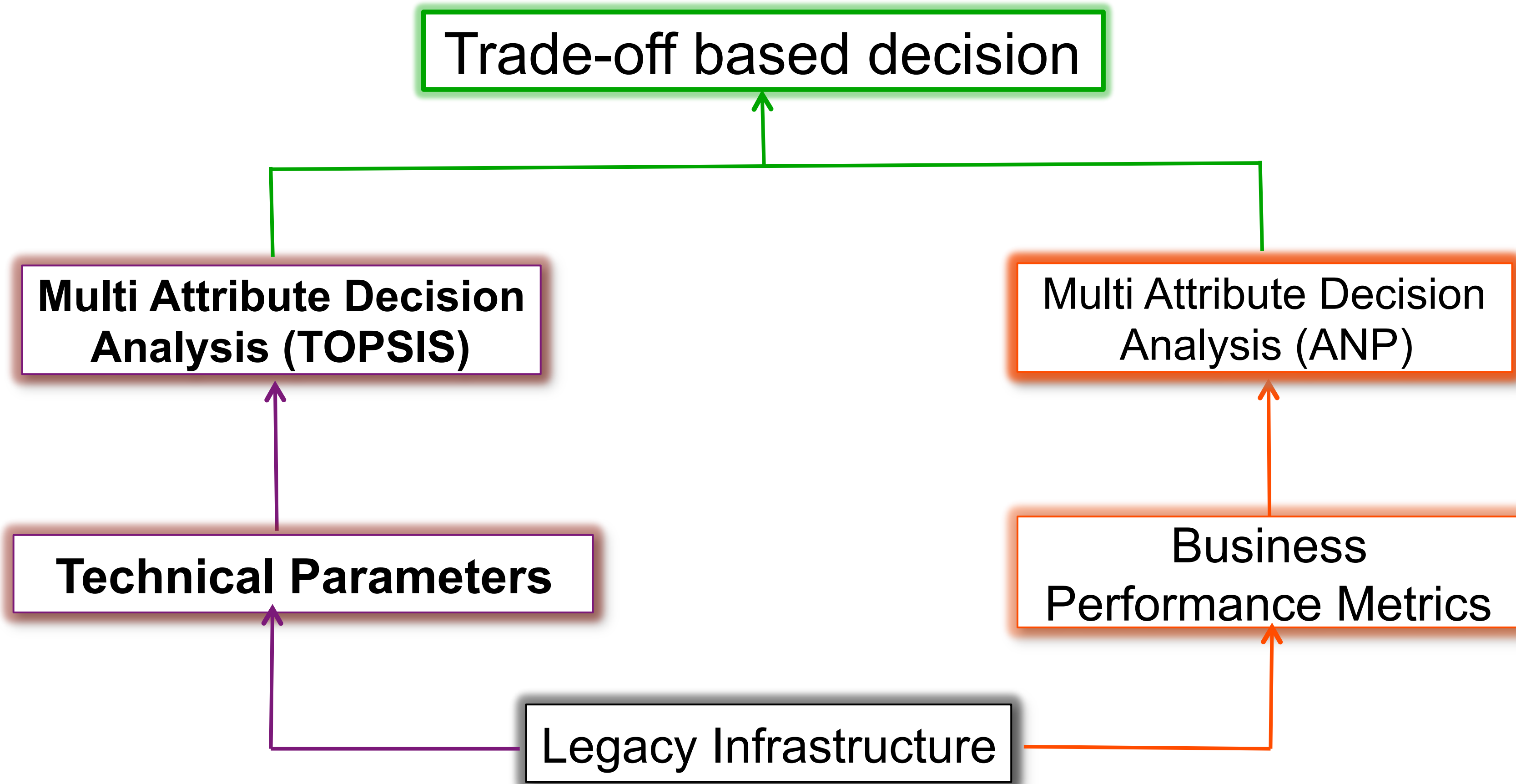

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TOPSIS (1)

- Assumes that *m* alternatives, *n* factors, the weight of each option is known, represented as matrix *X*.
- *X* is normalized to form normalized decision matrix as X*. New element is,

$$r_{ij} = \frac{x_{ij}}{\sum_{\substack{1 \le i \le m \\ 1 \le j \le n}} x^2_{ij}}$$

- Weighted normalized matrix is constructed, by multiplying each column of X* by its associated weight, w_{ij}. New element is,

$$v_{ij} = w_{ij} \times r_{ij}$$

TOPSIS (2)

- Determine the ideal positive $A^* = [V_1^*, V_n^*]$, where $V_j = \max(V_{ij})$, if $j \in J$ or $\min(V_{ij})$ if $j \in J'$ and negative solution $A' = [V_1', V_n']$, where $V_j' = \min(V_{ij})$ if $j \in J$ or $\max(V_{ij})$ if $j \in J'$.
- Determine the separation from the ideal solution for every alternative for $1 \le i \le m$.
  - Distance from positive ideal solution is $S_i^* = \sqrt{\sum (V_j^* - V_{ij})^2}$
  - Distance from negative ideal solution is $S_i' = \sqrt{\sum (V_j' - V_{ij})^2}$
- Determine the relative closeness, $C_i^* = \frac{S_i'}{S_i^* + S_i'}$, to the ideal solution.
  - Highest rank is given to alternative having C_i^* closest to 1.

Selection of Technical Parameters

- Selection of relevant factors
  - Based on current IT requirements
  - Based on business goals and policies
- Assigning priorities to factors
  - Based on criticality of business goals
    - E.g., Level of risk associated with vendor-lock in
- Assigning ranking of each Alternative (here A1, A2, A3)
  - For every factor

Weighted Normalized Decision Matrix

	A1	A2	A3
Functionality	2.001	1.710	1.410
Privacy	4.489	1.995	4.988
Availability	4.460	3.342	2.230
Scalability	2.340	3.745	2.340
Compliance	1.068	2.136	3.208
Storage Location	1.178	0.388	2.356
Simplicity	0.481	0.240	0.843

- Positive Ideal solution is set of maximum values: {2.001, 4.989, 4.460, 1.068, 2.356, 0.843}
- Negative Ideal solution is the set of minimum values: {1.410, 1.995, 2.230, 3.745, 3.208, 0.388, 0.240}

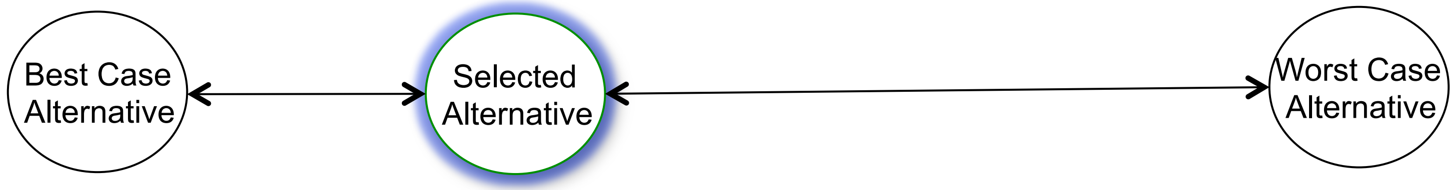
Distance of Alternatives from Ideal Solutions

Distance from the Positive Ideal Solution

	A1	A2	A3
Functionality	0.000	0.073	0.3111
Privacy	0.201	8.883	0.000
Availability	0.000	0.553	2.166
Scalability	0.000	1.625	0.000
Compliance	0.000	0.531	2.133
Storage Location	0.723	1.999	0.000
Simplicity	0.117	0.324	0.000
S^*_i	1.009	3.740	2.147

Ranking the Alternative Solutions

- Relative Closeness of the alternative to the ideal solution: {0.2363, 0.071, 0.2361}



- A1 and A3 are closer to the best solution as compared to A2
- Ranking of alternatives as per the technical factors
  – A1, A3, A2

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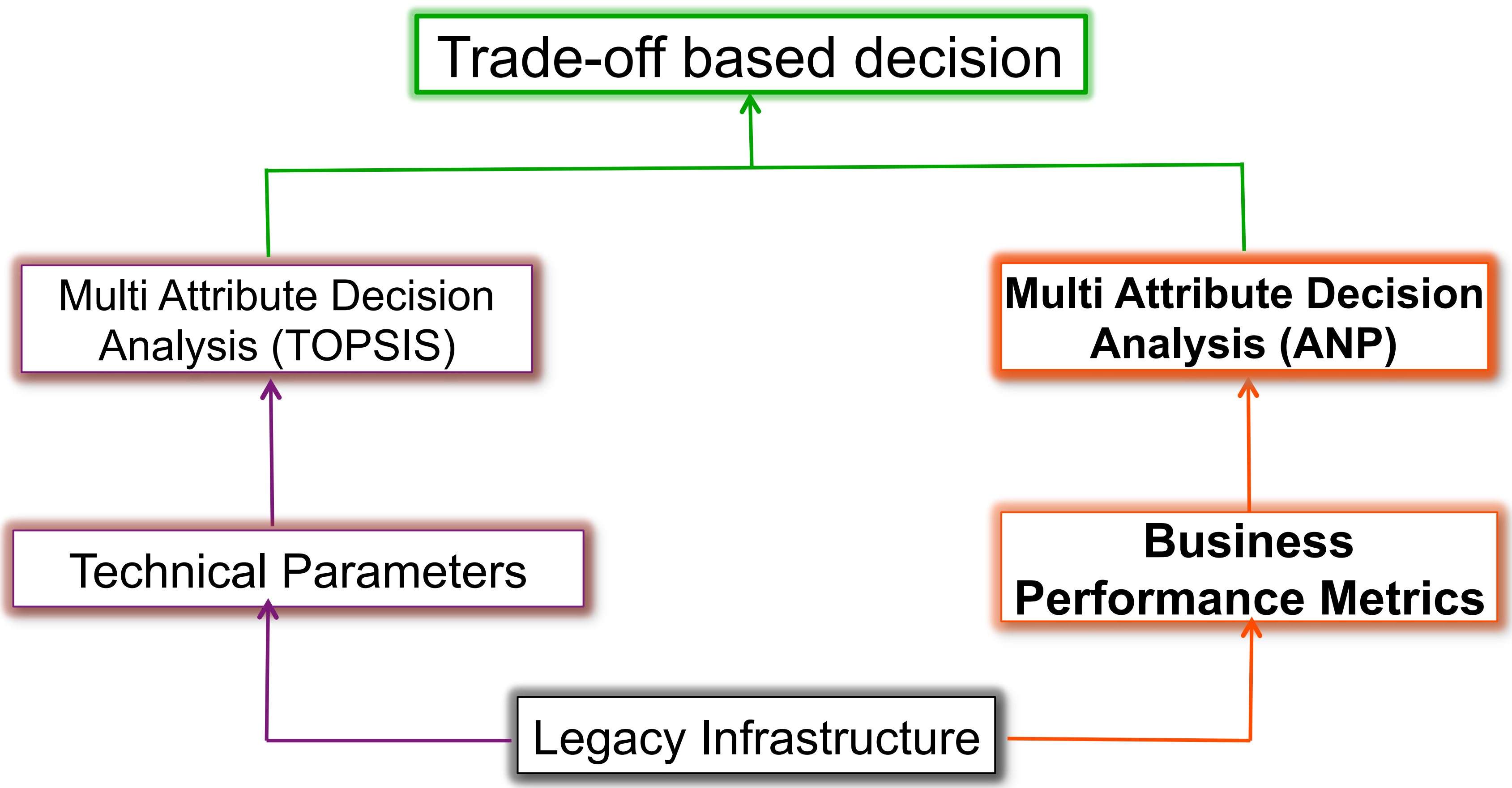

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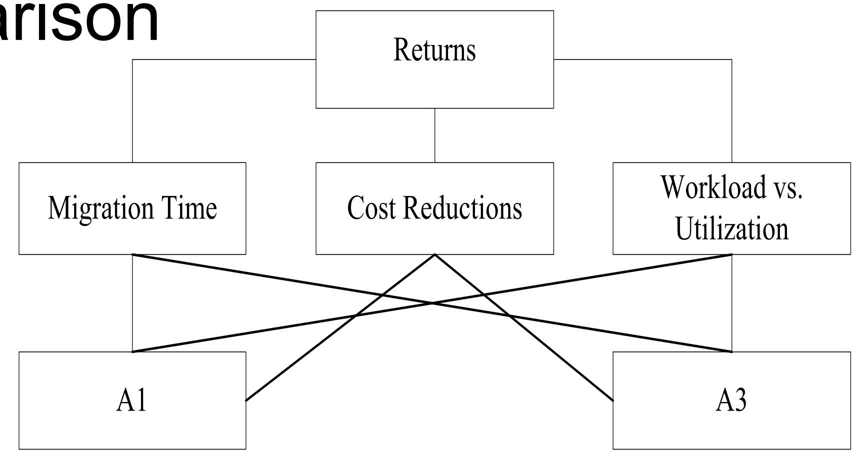
Selection of Business Performance Metrics (BPM)

- Identify BPMs for measuring returns
  - Measures Business Value
  - Identify relative importance of BPMs
    - E.g., Cost reduction is twice more important than migration time

BPMs	Migration Time	Cost reduction	Workload vs. Utilization
Migration Time	1	1/2	1/3
Cost Reduction	2	1	1/3
Workload vs. Utilization	3	3	1

Analytic Network Process (ANP)

- ANP makes a pair wise comparison of all nodes with respect to objective
- Eigen vector is calculated for local priorities for all connections



- The unweighted super matrix is normalized to calculate weighted super matrix
- The limit matrix is calculated, which is the weighted super matrix raise to the power of k+1, where k is an arbitrary positive integer

Weighted Super Matrix

	Returns	Migration Time	Cost Reduction	Workload vs. Utilization	A1	A3
Returns	1	0	0	0	0	0
Migration Time	16	1	0	0	75	13
Cost Reduction	25	0	1	0	13	75
Workload vs. Utilization	59	0	0	1	13	75
A1	0	50	20	67	1	0
A3	0	50	80	33	0	1

Limit Matrix for Returns

	Returns	Migration Time	Cost Reduction	Workload vs. Utilization	A1	A3
Returns	0	0	0	0	0	0
Migration Time	0	18	18	18	0	0
Cost Reduction	0	26	26	26	0	0
Workload vs. Utilization	0	6	6	6	0	0
A1	36	0	0	0	18	18
A3	64	0	0	0	32	32

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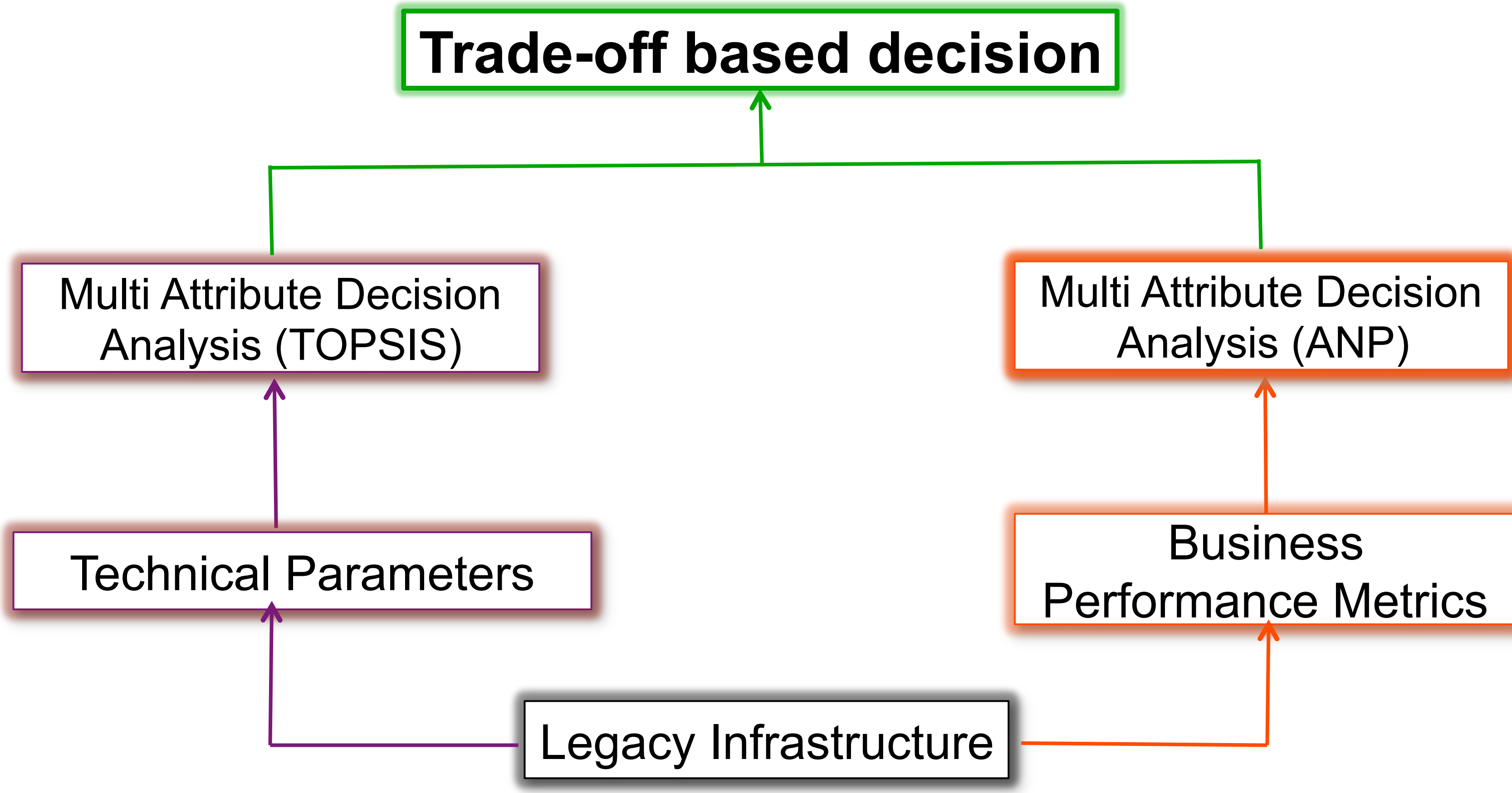

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Discussion on Trade-off-Based Decision

- A1 gained higher rank in TOPSIS with respect to technical factors
- A3 gained higher ranking in ANP with respect to BPM
- For trade-offs establishment
  - Priorities of BPMs are changed and seen if A1 is selected with ANP
  - If A1 is chosen with ANP, then best technical solution is chosen at a trade-off of return value in terms of BPMs

Summary

- Quantitative approach for decision making
  - Need identified by survey with organizations
  - Existing methods are ad-hoc
  - Based on proven multi attribute decision algorithms
  - TrAdeCIS enables comparative evaluation of alternatives
  - Being amenable to automation, complex arrays of criteria inputs can be handled

Thank You, for Your Attention!

References

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