IISE ANNUAL CONFERENCE & EXPO 2017

Cost-Effectiveness Analysis of Supplier Performance based on SCOR Metrics

Arun Vinayak

Graduate Research Assistant, IMSE dept. at Iowa State University

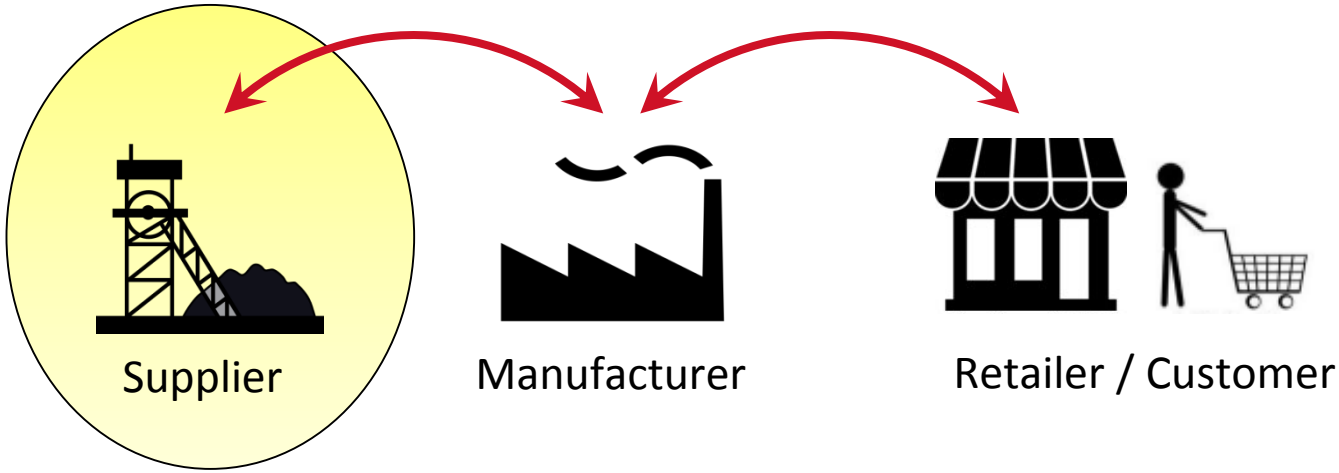
Cameron A. MacKenzie

Assistant Professor, IMSE dept. at Iowa State University

Introduction

- Supplier selection & evaluation using Multiple Criteria Decision Making (MCDM)

- Why MCDM?
  - Useful in understanding tradeoffs and evaluating risks associated with supplier alternatives that a firm has



Literature Review

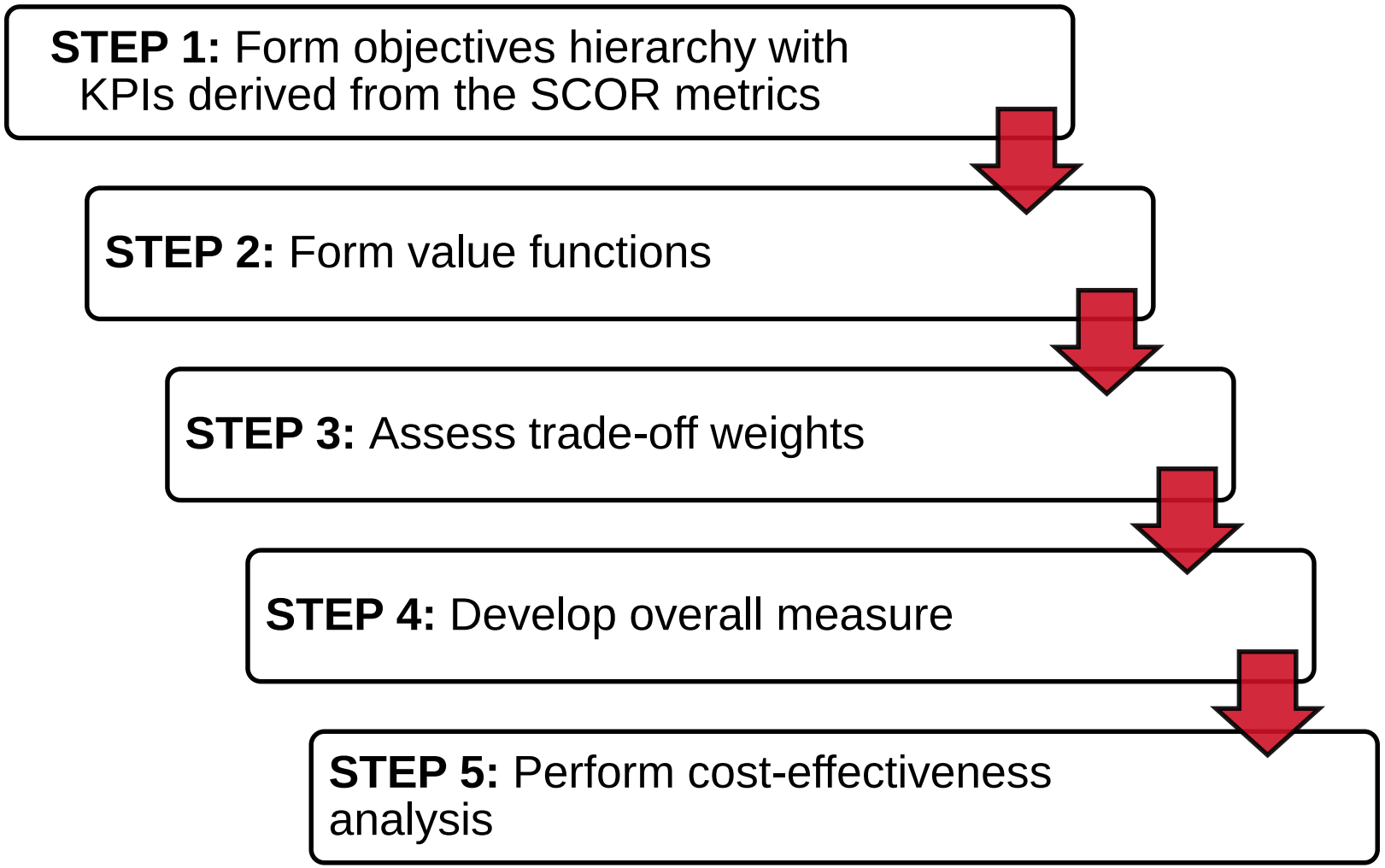
- Ho et al. (2010) analyzed MCDM approaches for supplier selection based on journal articles from 2000 to 2008
  - Identified Data Envelopment Analysis (DEA) as the most popular individual approach and Analytic Hierarchy Process (AHP) as the more prevalent integrated approach
  - Pointed out the limitations and drawbacks of DEA and AHP

- Lima-Junior and Carpinetti (2016) proposed a new approach that uses the metrics of the Supply Chain Operations References (SCOR) model to evaluate suppliers in the dimensions of cost and delivery performance using fuzzy TOPSIS, integrated MCDM method
  - Proposed further research in supplier evaluation using SCOR

Research Motivation & Contributions

- If a firm has little to no experience working with a supplier, a firm may have difficulty in objectively selecting a supplier
- Lack of alignment between supplier selection and supplier performance evaluation
- Literature in supplier selection focus on computationally intelligent methods to optimize the supplier selection process
- A novel supplier selection & evaluation framework
  - Systematic decision making frameworks
  - Focus on identifying the right objectives and priorities

Methodology

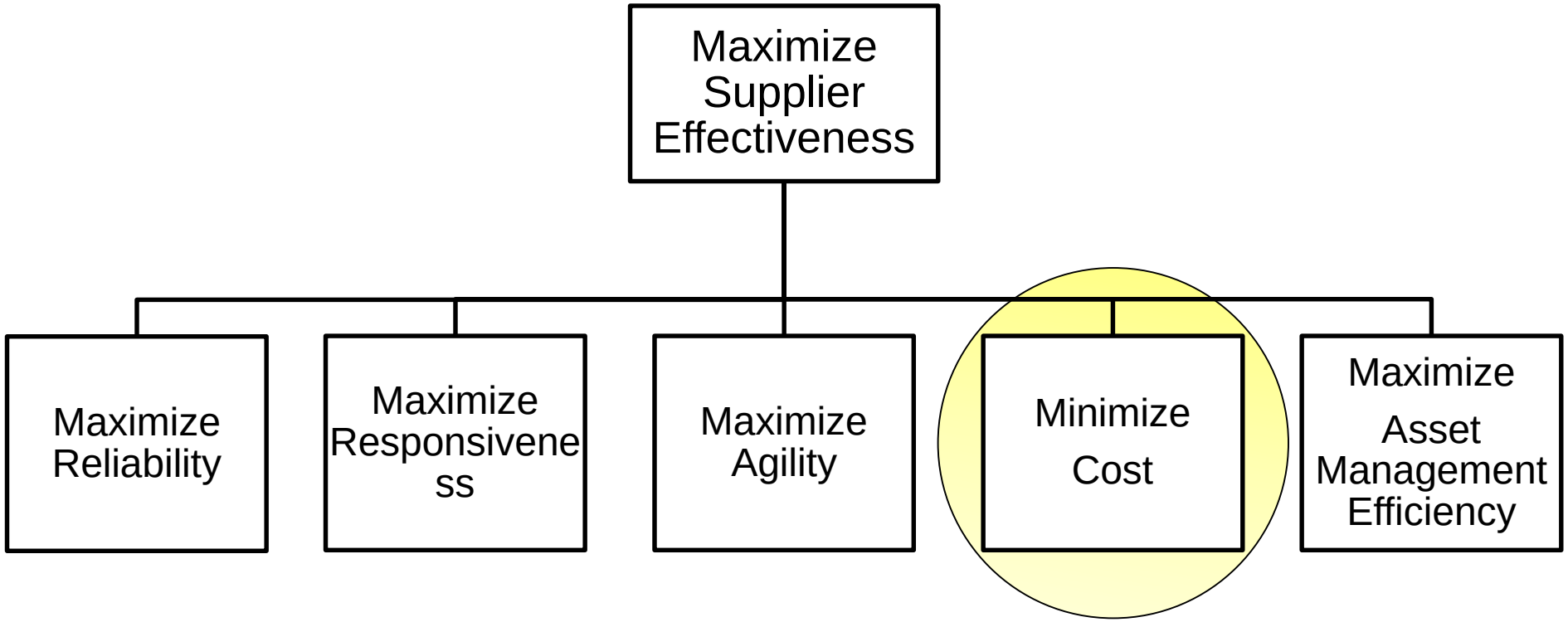


Overview of SCOR Performance Metrics

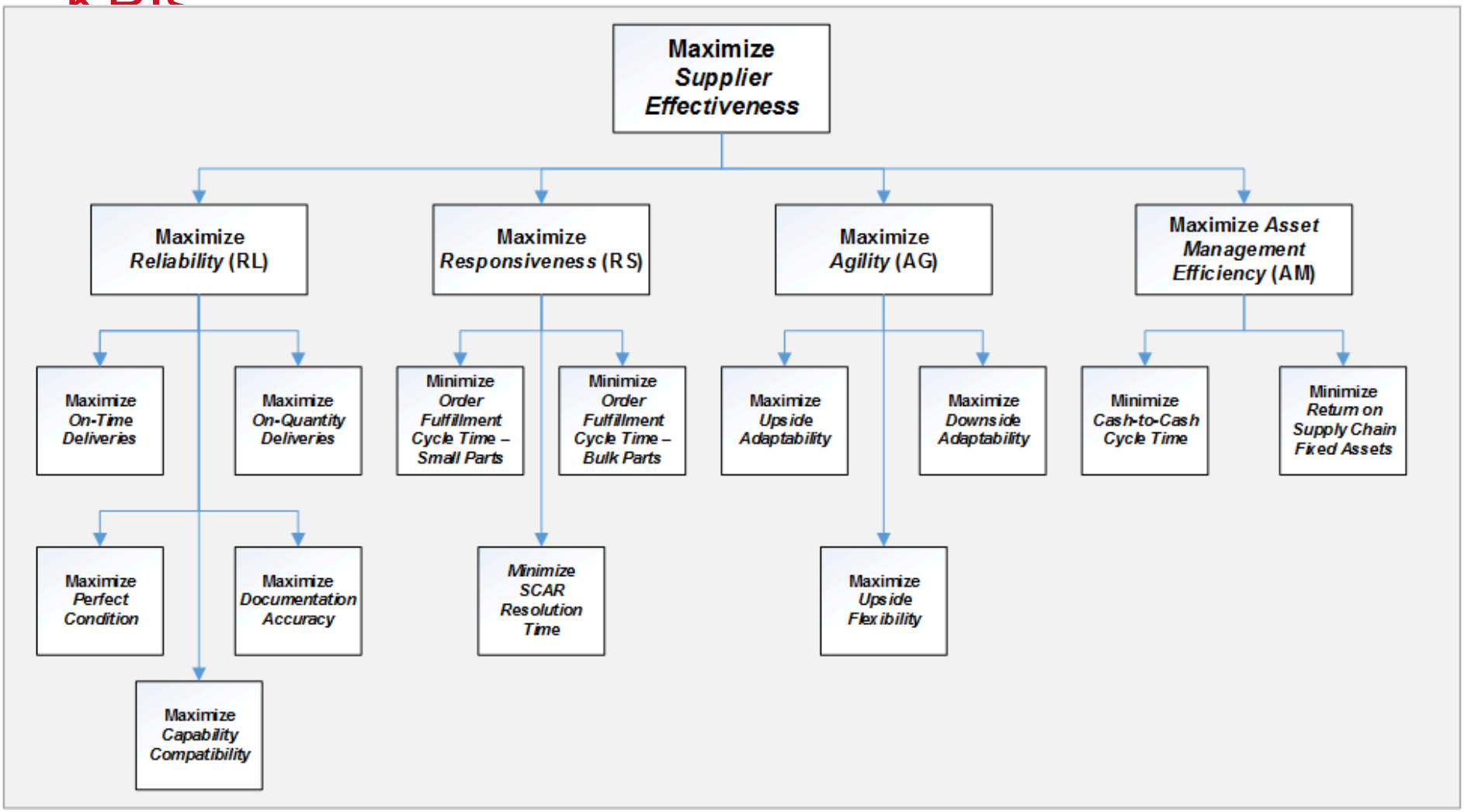
- Supply Chain Operations References model - Developed by the Supply Chain Council in 1996
- A very promising model for supply chain strategic decision making
- Allows firms to perform very thorough fact based analysis of all aspects of their supply chain by providing a complete set of process details, performance metrics, and industry best practices
- Identifies 5 core supply chain performance attributes with 10 level-1 metrics and 43 level-2 metrics

Huan, S. H., Sheoran, S. K., & Wang, G. (2004). A review and analysis of supply chain operations reference (SCOR) model. Supply Chain Management: An International Journal, 9(1), 23-29.

From SCOR to Objectives Hierarchy

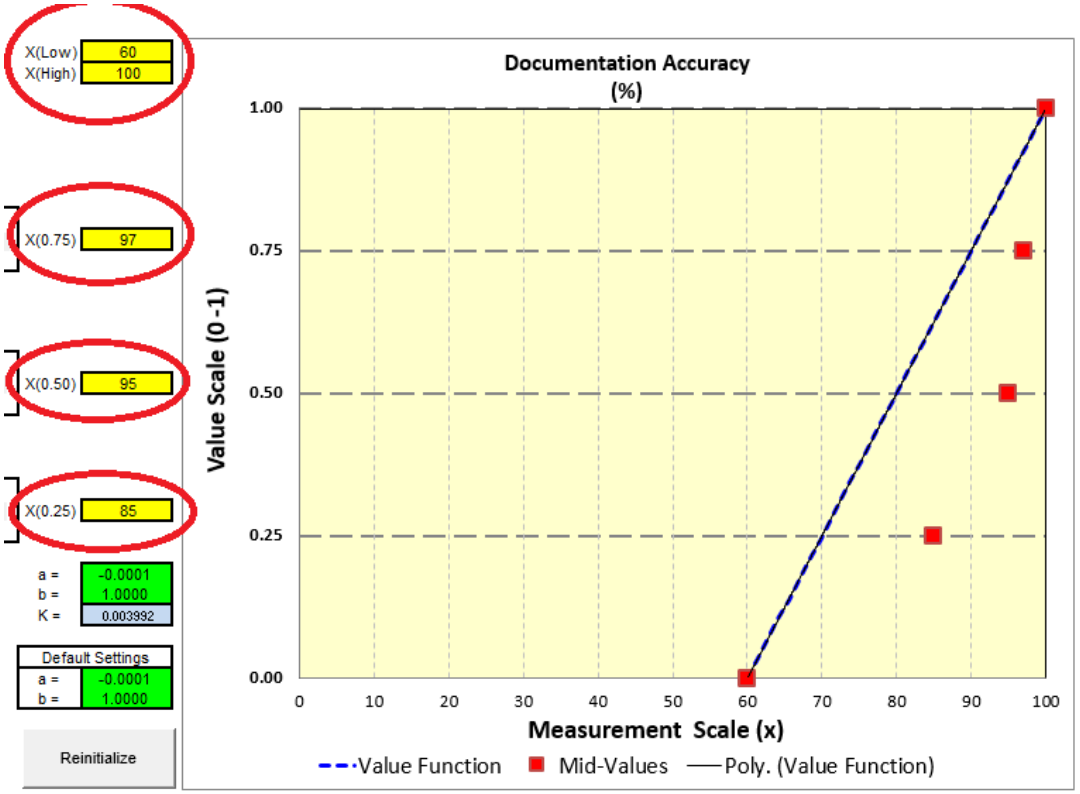


Objectives Hierarchy: From SCOR Metrics to KPIs



Value Functions & Trade-off Weights

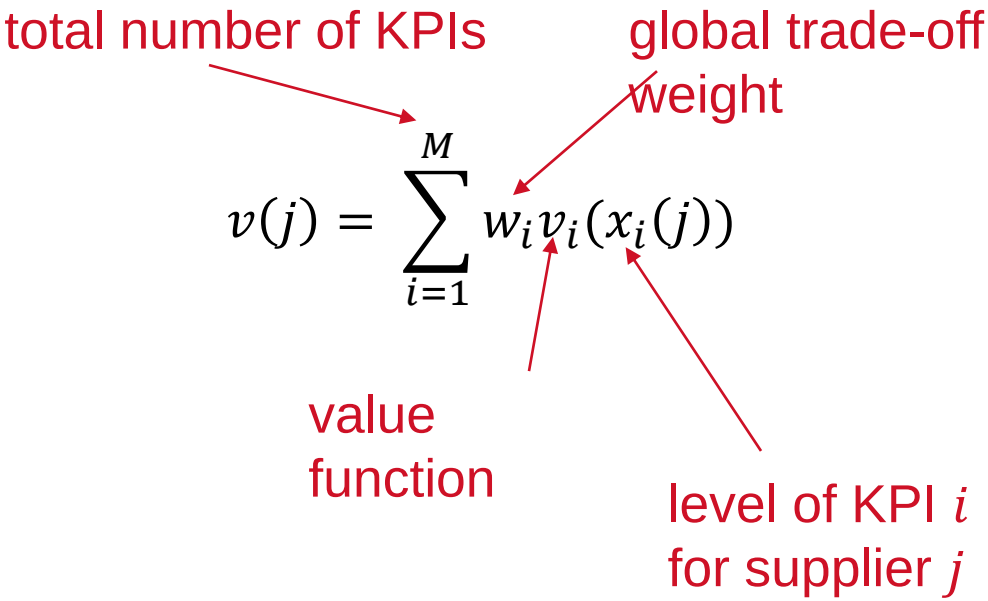
- A scalar index that represents decision makers' preferences
- Mid-value Splitting Technique
- Excel tool for value function assessment
- Trade-off weights
- Swing weight



Keeney, R. L., & Raiffa, H. (1993). Decisions with multiple objectives: preferences and value trade-offs. Cambridge university press.

Overall Measure: Supplier Effectiveness

Supplier effectiveness combines all the KPIs into a single measure of the overall effectiveness for each supplier using the value functions and weights.



Cost-Effectiveness Analysis

- A simple two-dimensional graphical comparison of the overall measure supplier effectiveness with cost.

- Objectives:
  1. Maximize Effectiveness
  2. Minimize Cost

- The firm needs to consider the benefits or incremental effectiveness gained by sourcing from a more expensive supplier and consider the trade-off between cost and effectiveness

- Plotting the cost and effectiveness of each supplier on a graph can help visualize this trade-off and identify an efficient solution set

Illustrative Example and Analysis

- Based on real world expertise for a typical case of an automotive manufacturer.
- One decision maker from supply chain area and other from manufacturing were interviewed and walked through the methodology for the selection and definition of the KPIs, development of value functions, and trade-off weight assessment.
- The objective is to evaluate the performance of 8 suppliers.
- Although, this is illustrative in nature, based on the author and industry experts' experience, the numbers closely align with what an automotive manufacturer would encounter.

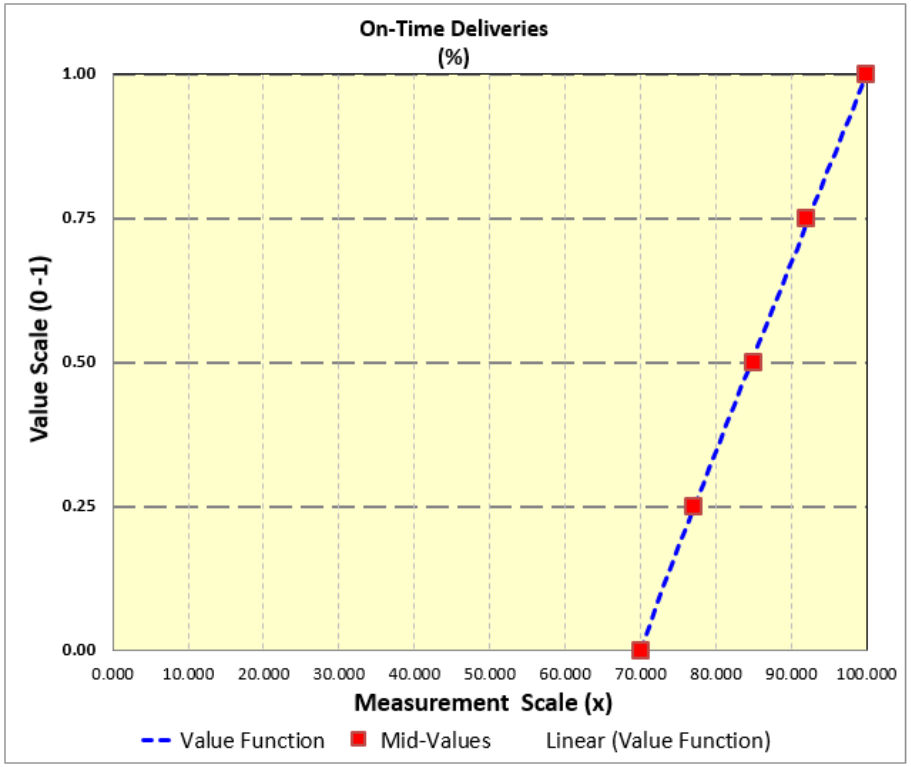
Illustrative Example and Analysis (cont.)

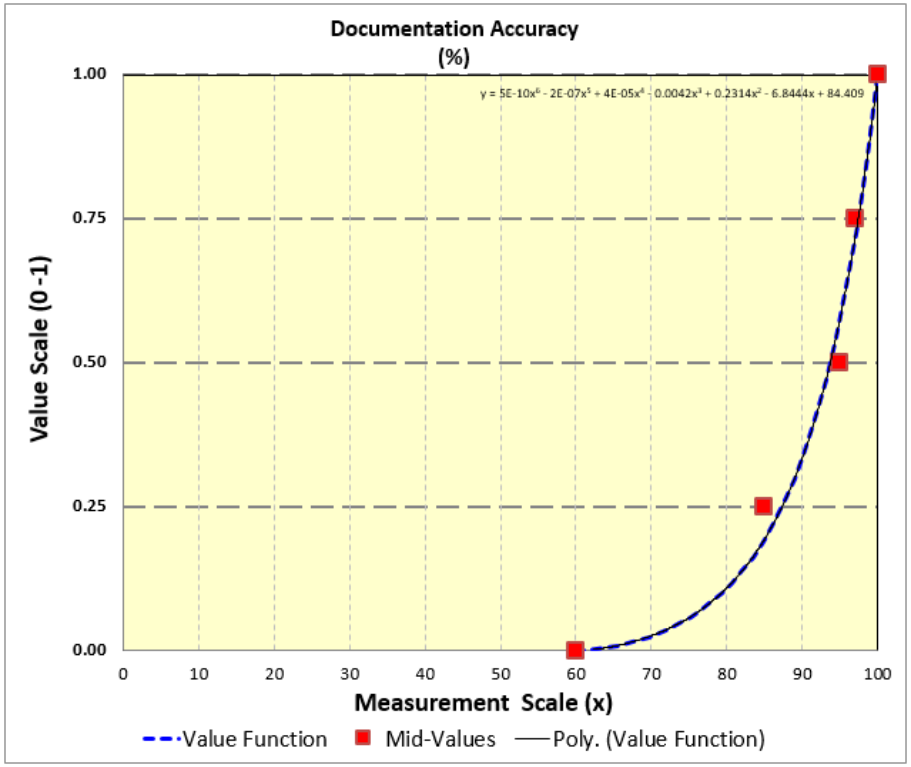
KPI values for the 8 suppliers

- Reliability
  - On-time deliveries (%) ranges from 73 to 95
  - On-quantity deliveries (%) ranges from 59 to 100
  - Perfect condition (%) ranges from 90 to 100
  - Documentation accuracy (%) ranges from 67 to 96
- Responsiveness
  - Order fulfillment cycle time – small parts (days) ranges from 1 to 5
  - Order fulfillment cycle time – large parts (days) ranges from 0.5 to 3
  - SCAR resolution time (days) ranges from 8 to 27
- Agility
  - Upside flexibility (days) ranges from 0 to 77
  - Upside adaptability (%) ranges from 24 to 203
  - Downside adaptability (%) ranges from 3 to 50
- Asset Management Efficiency
  - Cash-to-cash cycle time (days) ranges from 47 to 140
  - Return on supply chain fixed assets ranges from 0.08 to 0.73

Illustrative Example and Analysis (cont.)

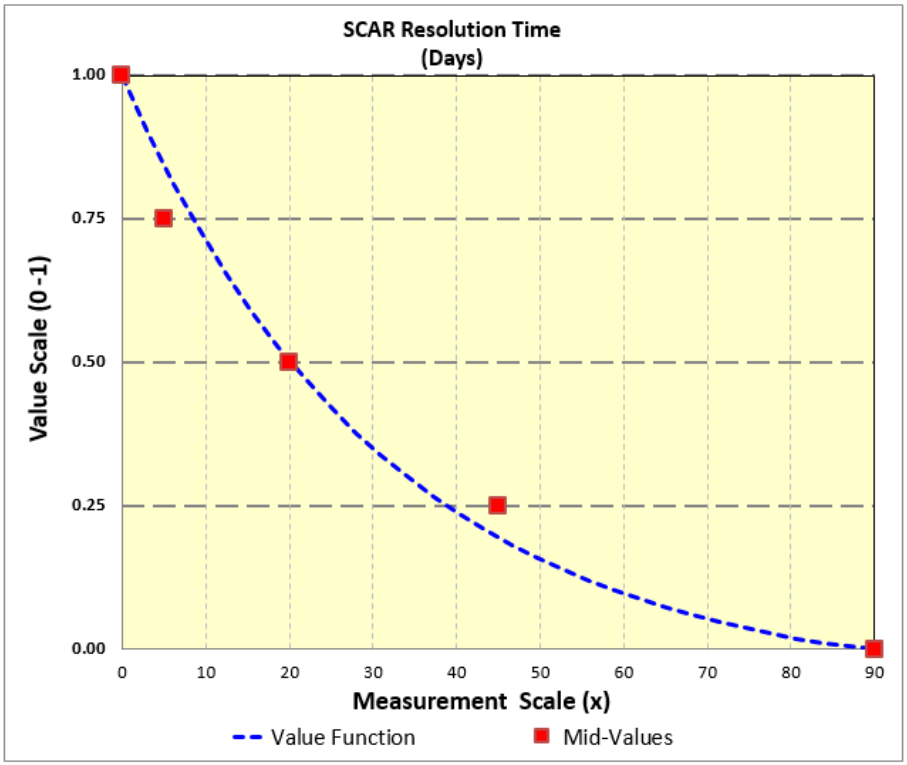
Assessed Value functions – On-time delivery & Documentation accuracy

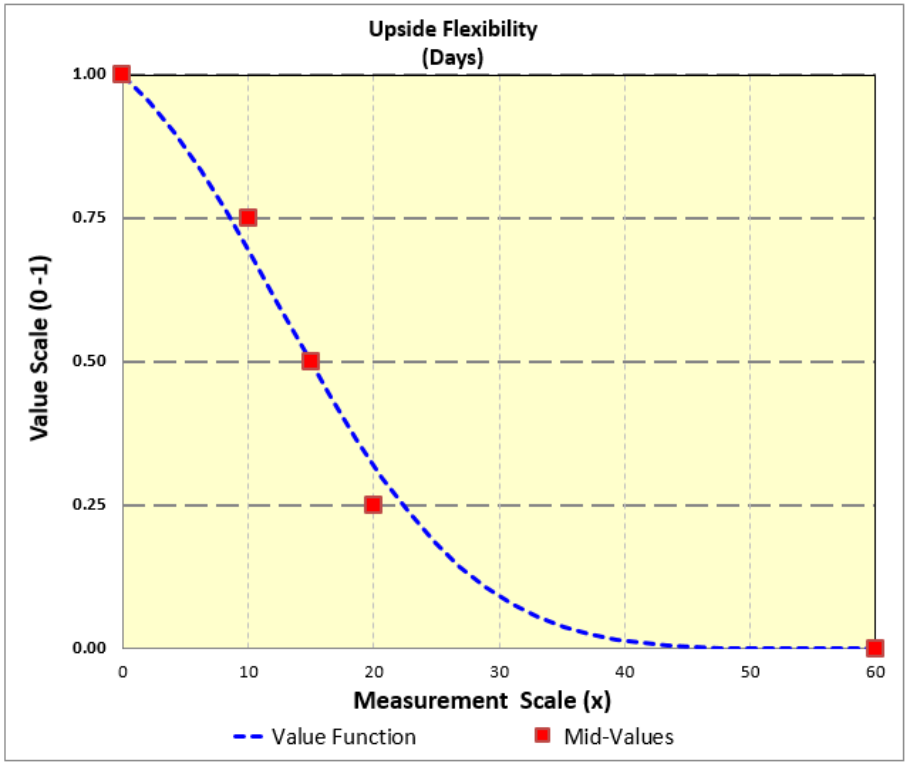




Illustrative Example and Analysis (cont.)

Assessed Value functions – SCAR resolution time and Upside flexibility



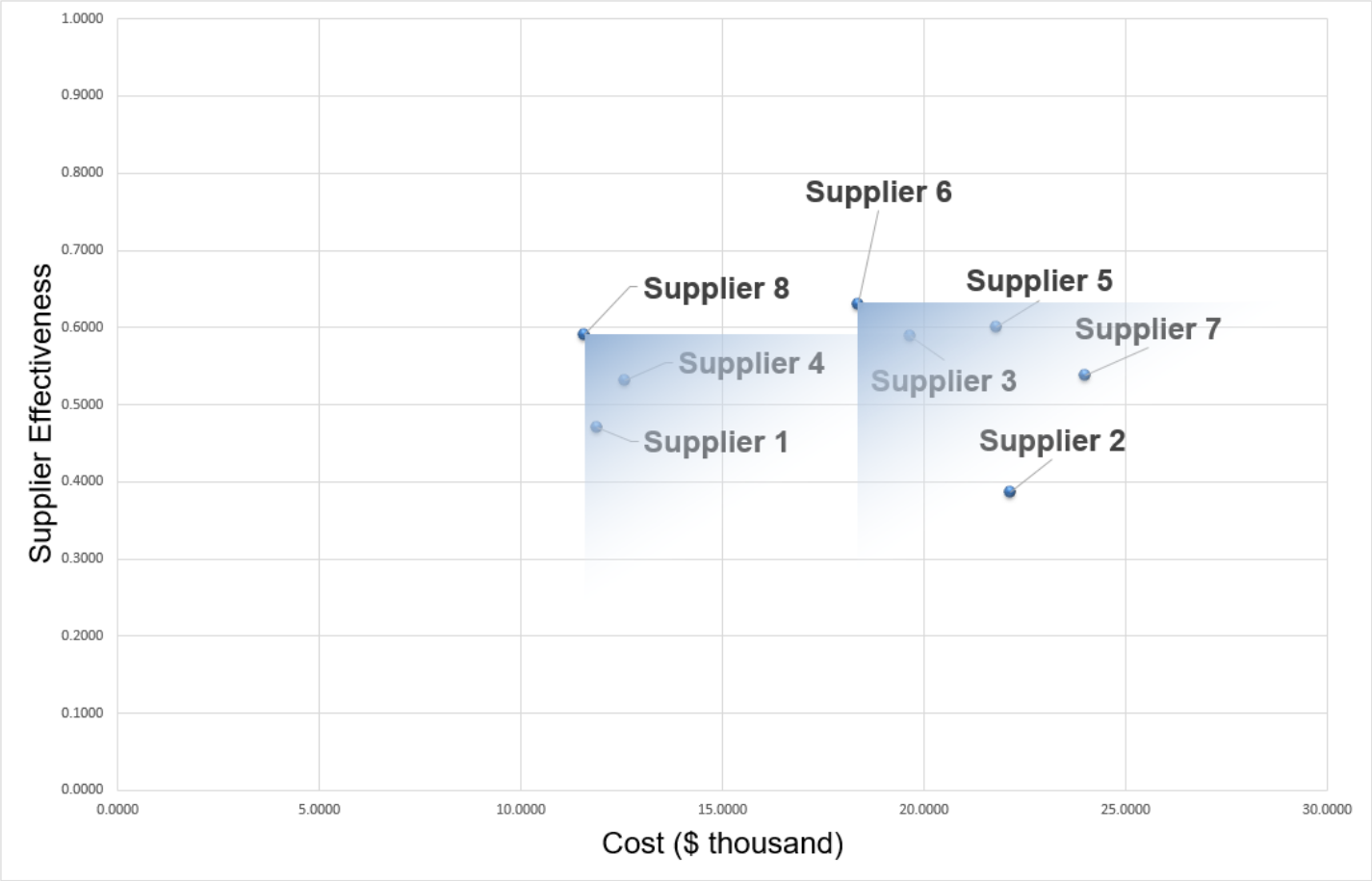


Illustrative Example - Global trade-off weights

Attribute	KPI	Global weight
Reliability	On-Time Deliveries	0.14
	On-Quantity Deliveries	0.0875
	Perfect Condition	0.105
	Documentation Accuracy	0.0175
Responsiveness	Order Fulfillment Cycle Time – Small Parts	0.12
	Order Fulfillment Cycle Time – Large Parts	0.12
	SCAR Resolution Time	0.06
Agility	Upside Flexibility	0.06
	Upside Adaptability	0.045
	Downside Adaptability	0.045
Asset Management Efficiency	Cash-To-Cash Cycle time	0.14
	Return on Supply Chain Fixed Assets	0.06

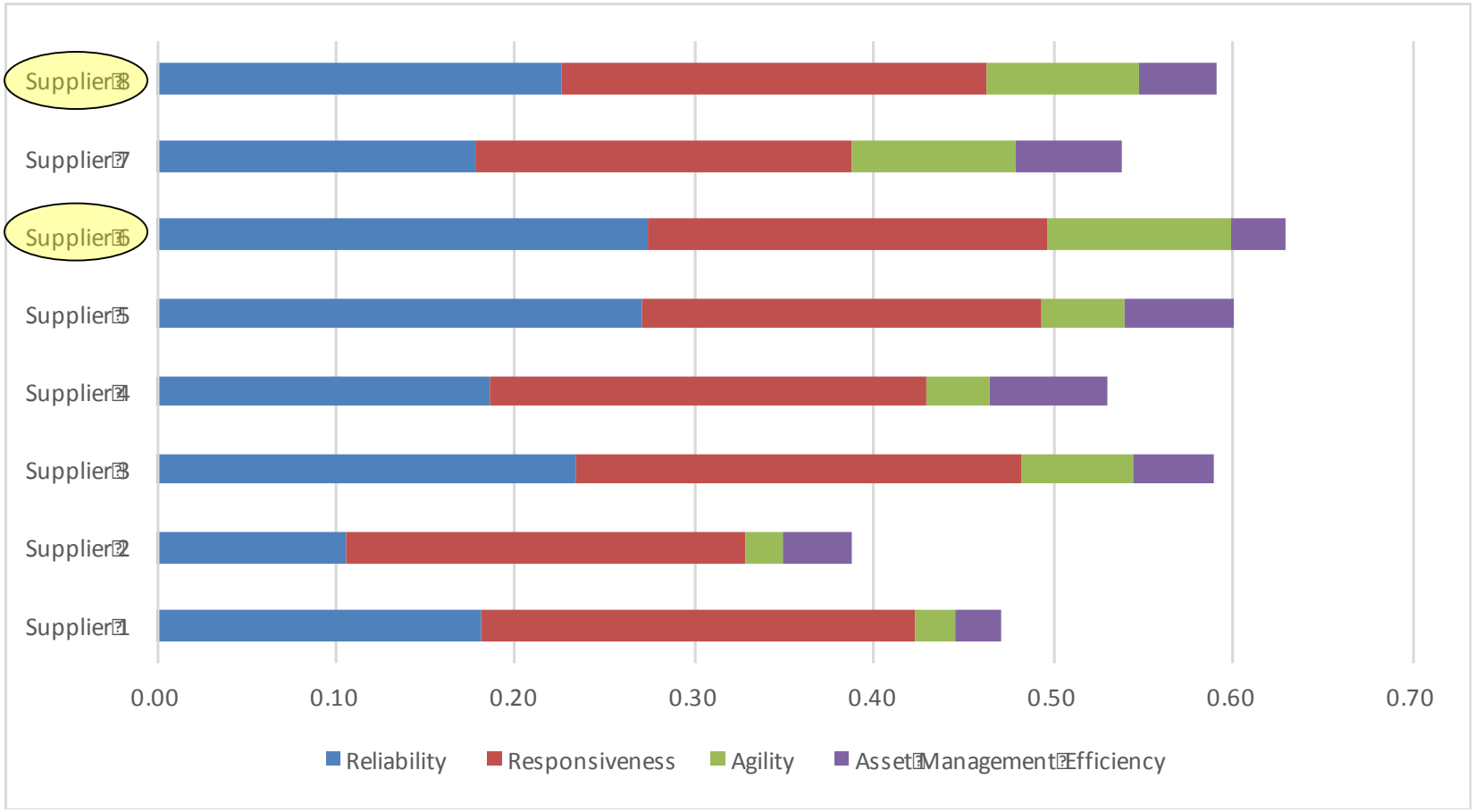
Illustrative Example and Analysis (cont.)

Cost-Effectiveness Analysis



Illustrative Example and Analysis (cont.)

Marginal reasoning solution



Limitations & Future Work

- Certainty assumption
  - Non-deterministic case
- Updating and reassessing supplier effectiveness
  - Bayesian updating
- Case study applications in manufacturing companies with different supply chain strategies such as lean, agile, etc.
- Further development of objectives hierarchy to include other supplier KPIs that are not covered in the SCOR model
  - Expedition capability.

Conclusions

- KPIs derived from SCOR performance metrics for evaluation of suppliers from a firm's perspective

- A novel framework for calculating and comparing the cost-effectiveness of suppliers for supplier selection and evaluation
  - 5-step methodology
  - Illustrative example based on real world expertise
  - Flexible model
  - Excel tool for real world application
  - Value based approach

Thank You!

vinayak@iastate.edu