

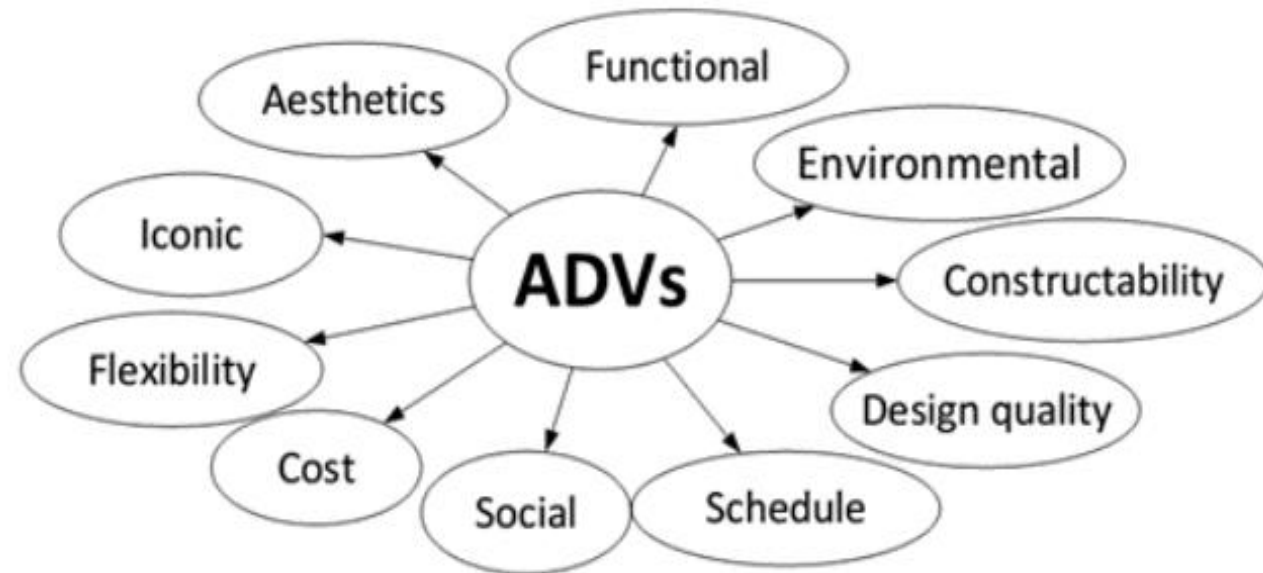
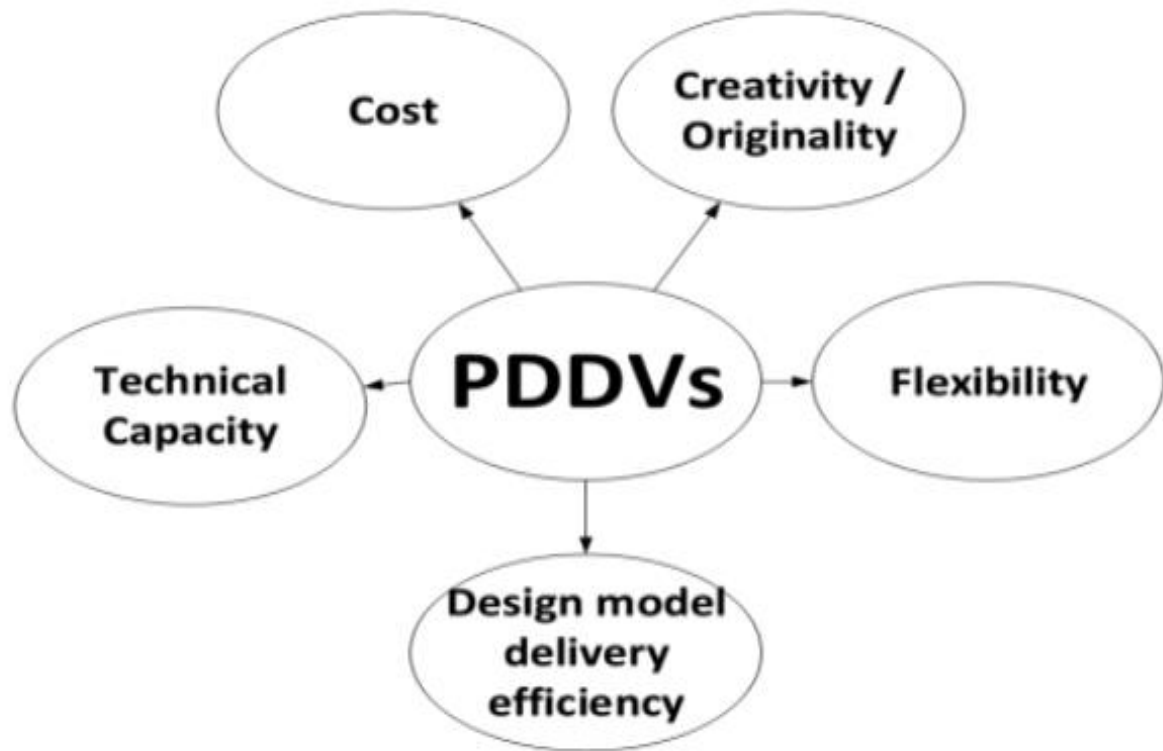
AHP AND CBA APPLICATION TO LAYOUT DESIGN: A CASE OF CLASSROOM LAYOUT ASSESSMENT

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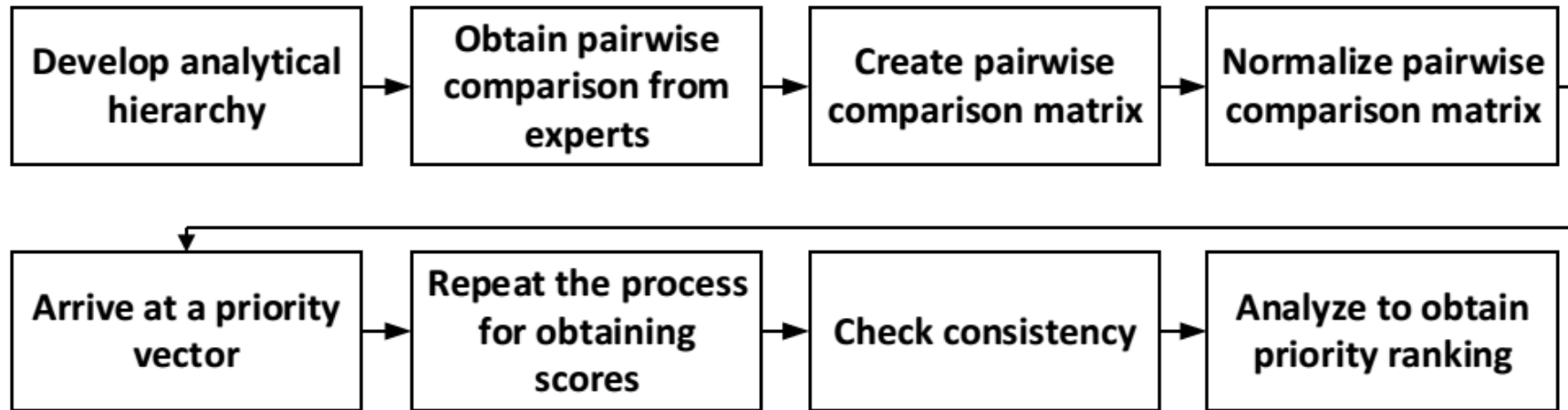
INTRODUCTION

- **Diverse and multidisciplinary stakeholders with conflicting objectives**
- **Lean literature – TFV, TVD, CBA, etc.**
- **CBA and AHP applications in AEC design decisions** (Parrish and Tommelein 2012; Arroyo et al. 2012; Arroyo et al. 2013; Arroyo et al. 2016; Arroyo et al. 2015; Schottle et al. 2017; Karakhan et al. 2016; Shapira and Golderberg 2005 & Dey 2003)

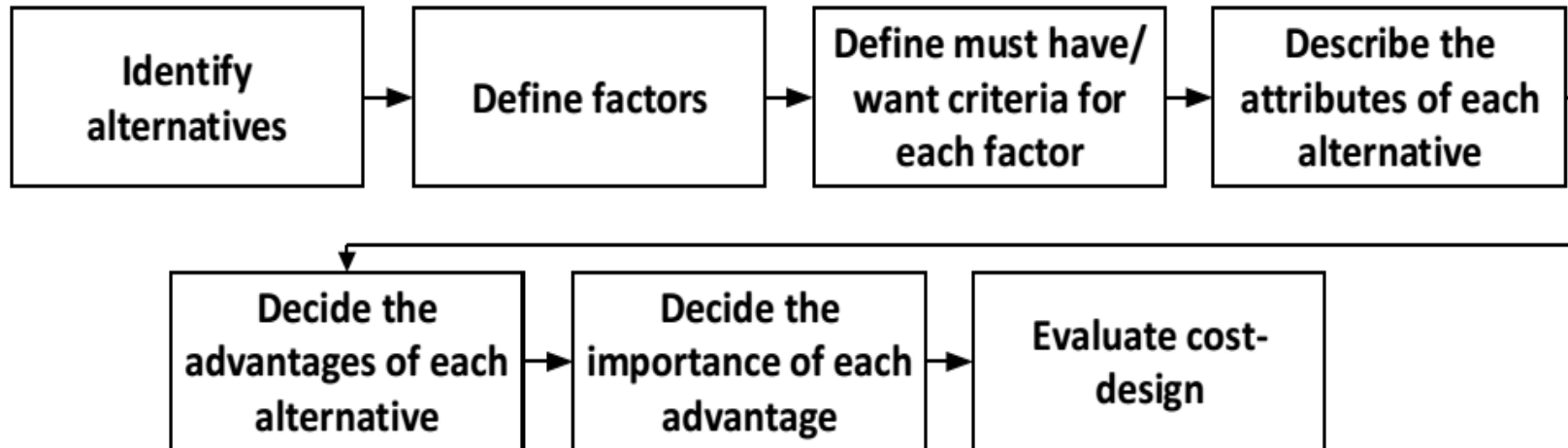
Stakeholder Values - The Case of University Campus Bldgs. (Sahadevan and Varghese 2018)



AHP v/s CBA

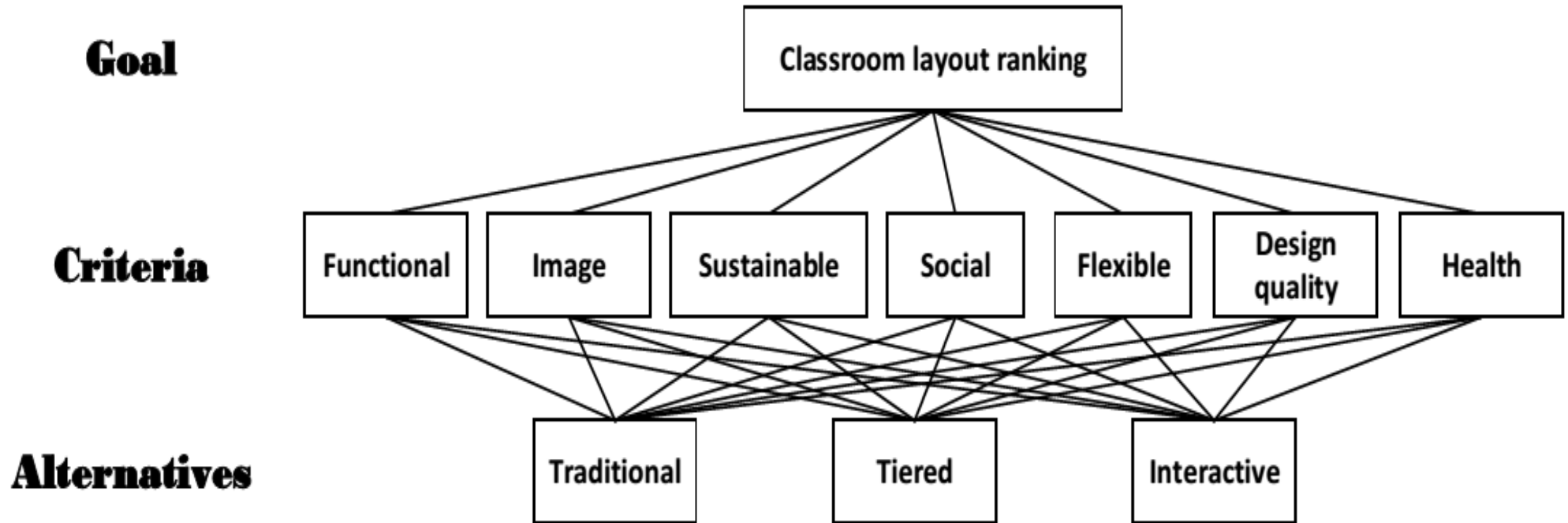


AHP steps

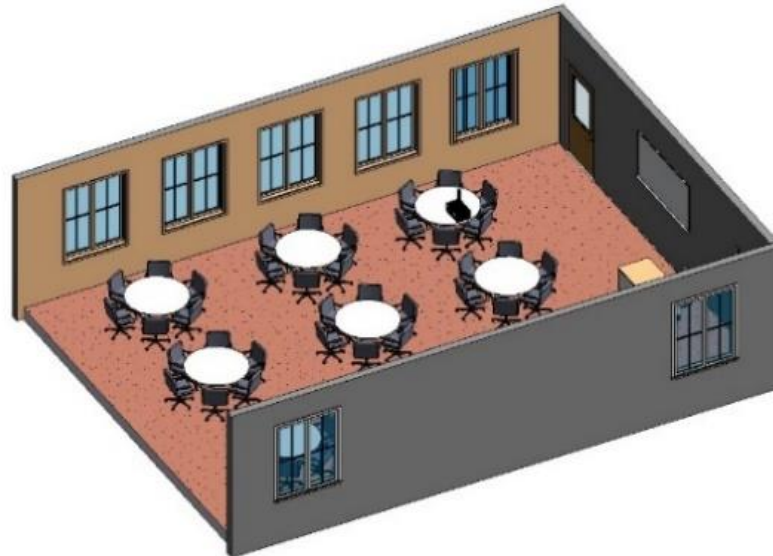
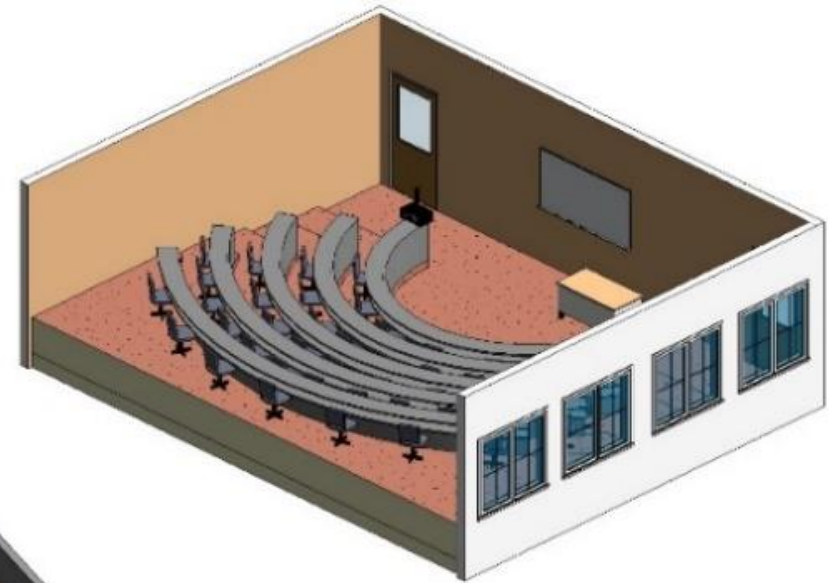
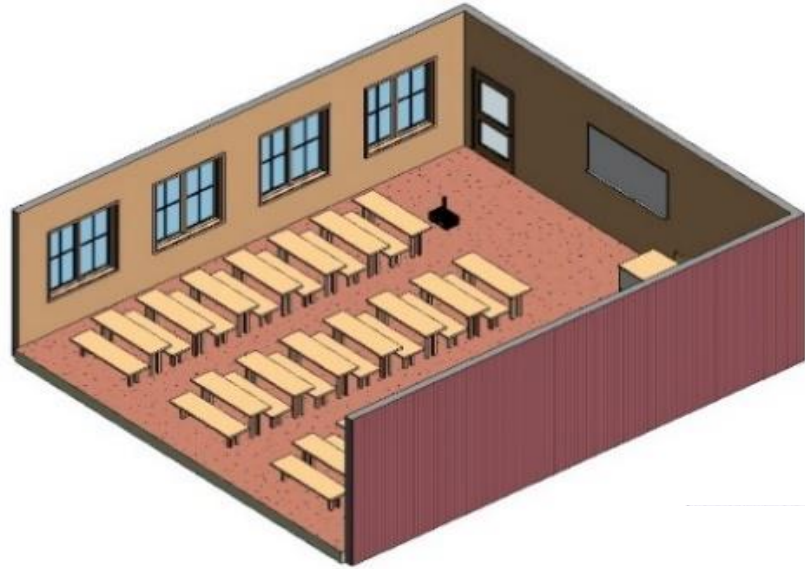


CBA steps

Criteria for Layout Evaluation



RESEARCH METHOD



RESEARCH METHOD

Category	Layout 1	Layout 2	Layout 3
Type of classroom	Traditional	Tiered	Interactive
Capacity (seater)	42	45	45
Area (sq.m.)	119	110	141
Cost (₹)	6,95,000	12,57,000	8,00,000
Embodied Energy (GJ)	1401	2995	1123
Reverberation time (s)	0.34	0.28	0.5

RESEARCH METHOD

Selection of participants



Elicitation of ad-hoc judgement



Familiarizing with CBA & AHP vocabulary



Elicitation of criteria for decision making



AHP & CBA sessions

RESULTS - AHP

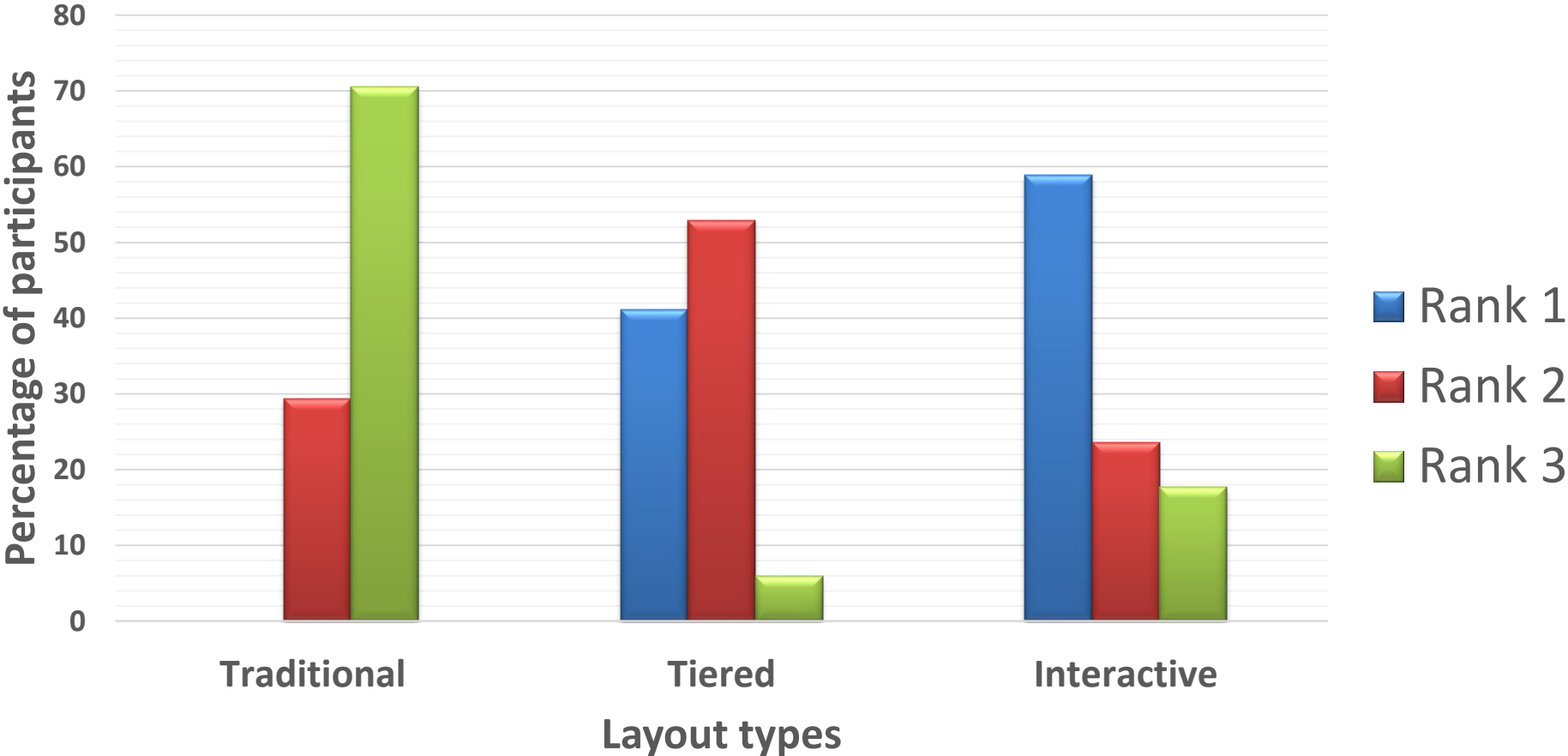
Individual Judgement

	Rank 1	Rank 2	Rank 3
Faculty 1	Tiered	Interactive	Traditional
Faculty 2	Tiered	Traditional	Interactive
Faculty 3	Interactive	Traditional	Tiered
Faculty 4	Tiered	Traditional	Interactive

AHP scores

	Traditional	Tiered	Interactive
Faculty 1	0.280	0.332	0.388
Faculty 2	0.275	0.315	0.41
Faculty 3	0.07	0.707	0.223
Faculty 4	0.742	0.183	0.075

RESULTS - CBA

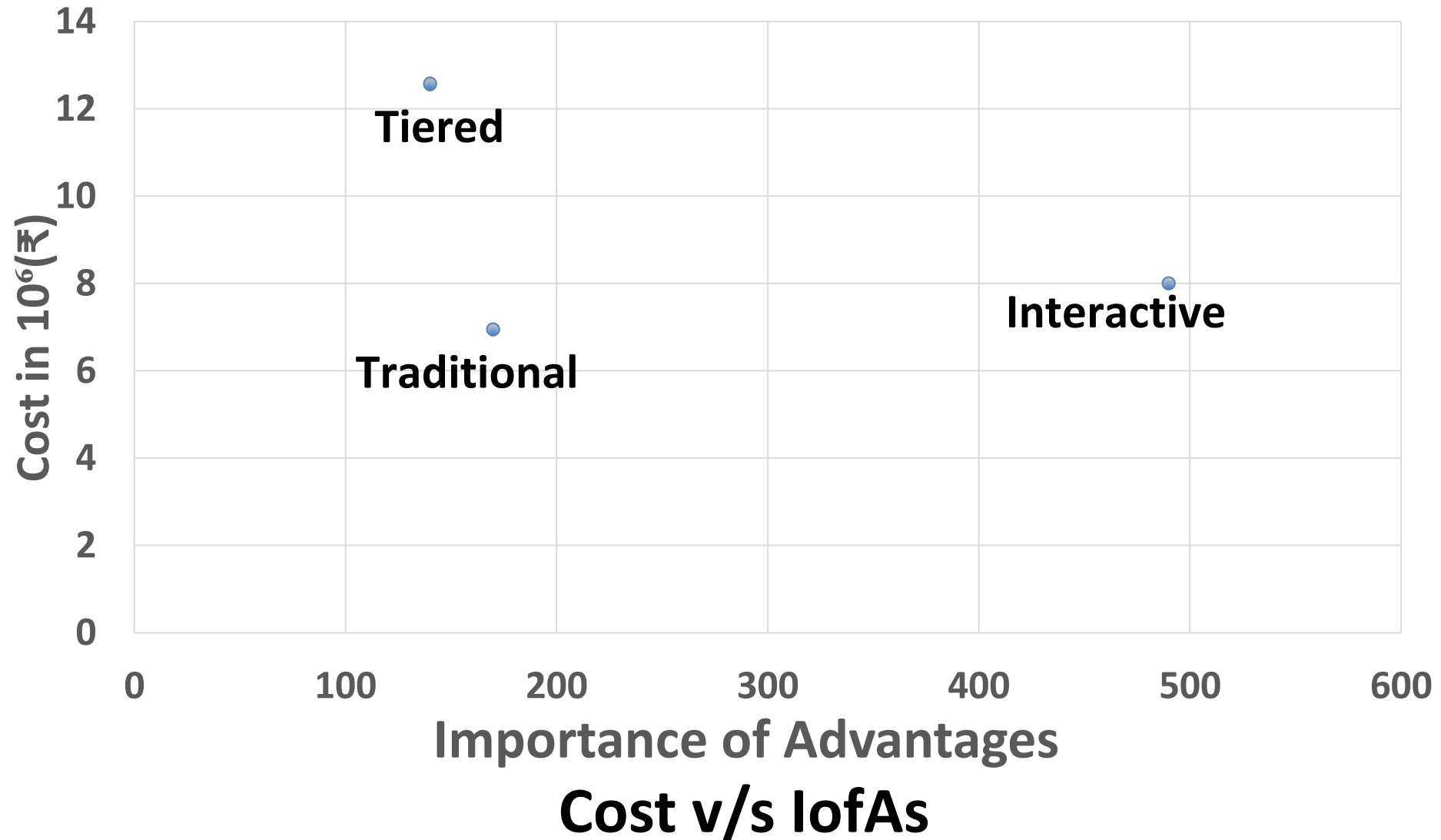


Ad-hoc judgement

RESULTS - CBA

Factors	Alt.1: Traditional		Alt.2: Tiered		Alt.3: Interactive	
1. Functional 1a. Provision of all classroom requirements Crit.: Higher is better	Att: Provided		Att: Provided		Att: Provided	
	Adv.:	IofA:	Adv.:	IofA:	Adv.:	IofA:
1b. Acoustics Crit.: Reverberation time (s) within permissible limits	Att: 0.34 (within permissible limits)		Att: 0.28 (within permissible limits)		Att: 0.5 (within permissible limits)	
	Adv.:	IofA:	Adv.:	IofA:	Adv.:	IofA:
1c. Planning of spaces & circulation Crit.: Better ability to walk around the classroom	Att: Some circulation space		Att: <u>Less circulation space</u>		Att: More circulation space	
	Adv.: Some ease for users to move around in the classroom	IofA:20	Adv.:	IofA:	Adv.: More ease for users to move around in the classroom	IofA:100
1d. Electrical layout Crit.: Better accessibility of charging points	Att: Adequate accessibility		Att: Adequate accessibility		Att: Adequate accessibility	
	Adv.:	IofA:	Adv.:	IofA:	Adv.:	IofA:
2. Image Crit.: More appealing is better	Att: Some orderly arrangement		Att: Orderly		Att: <u>Least appealing/ could get disorderly</u>	
	Adv.: Less visual appeal	IofA:30	Adv.: <i>Visually appealing</i>	IofA:90	Adv.:	IofA:
3. Sustainable Crit.: Embodied Energy (GJ), lower is better	Att: 1401		Att: <u>2995</u>		Att: 1123	
	Adv.:1594	IofA:50	Adv.:	IofA:	Adv.:1872	IofA:60
4. Design quality Crit.: More the area (sq. m.) was considered better for the user	Att: 119		Att: <u>110</u>		Att: 141	
	Adv.:9	IofA:30	Adv.:	IofA:	Adv.:31	IofA:90
5. Social Crit.: Higher interaction opportunities are better	Att: <u>Low interaction opportunities</u>		Att: Moderate interaction opportunities		Att: High interaction opportunities	
	Adv.:	IofA:	Adv.: Somewhat social	IofA:50	Adv.: <i>More social</i>	IofA:90
6. Flexible Crit.: Ease of future adaptability to changes, higher is better	Att: Can be modified with some ease		Att: <u>Cannot be modified easily</u>		Att: Can be modified with greater ease	
	Adv.: Somewhat adaptable	IofA:40	Adv.:	IofA:	Adv.: <i>More adaptable</i>	IofA:60

RESULTS - CBA



DISCUSSION

- **Role of individual preferences in decision making**
- **Soundness of decision making**
 - Consistency
 - Context-specific
 - Transparency of trade-offs within and among factors
 - Subjectivity
 - Collaboration and transparency
 - Abstractness of criteria
- **Ease of operationalizing of the techniques**

CONCLUSIONS

● AHP

- Capturing individual preferences
- Subjective and abstract criteria
- Provides structure
- Issues with consistency and trade-offs

● CBA

- Informed collaborative decision
- Transparency
- Sound criteria and sub-criteria

Questions???