The Seventeenth International Conference on Future Computational Technologies and Applications

FUTURE COMPUTING 2025

April 06, 2025 to April 10, 2025 - Valencia, Spain

Treatment of the Multi-Attribute Decision-Making Rank Reversal Problem for Real-World Systems

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Thank you to the reviewers and conference organizers.

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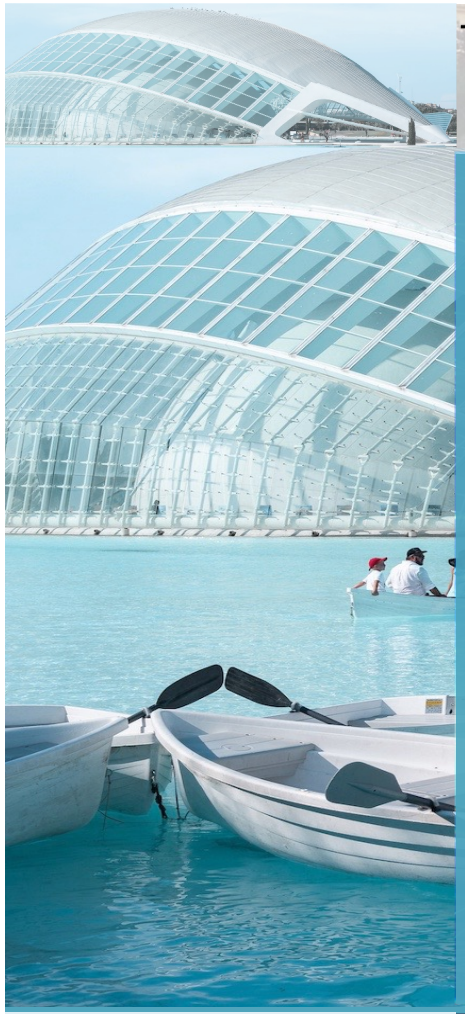

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Introduction

- **Build me a Real-World Scenario (RWS) AI System (AIS)!**
- **Certain clarifications are needed; what about the data?**
  - The collection, ingestion, and processing of the requisite data may be non-trivial.
  - Triantaphyllou notes that “pertinent data are very expensive to collect.”
- **Certain considerations are needed; is it a local or global AIS?**
  - The reviewer(s) expertise level might vary by locale with the association selection biases (e.g., will the AIS be more software or hardware-centric).
  - What type of weighting is envisioned? What is the level of granularity, accuracy vs. precision desired?
- **Certain aspects need to be considered; is it a Minimum Viable Product (MVP)? What about the timing?**

  Is Rapid Application Development (RAD) expected?
  - Lean engineering teams seeking to develop the Robinson-Blank-Ries notion of MVP might use various packages from Github for RAD. Are there errors/vulnerabilities are contained within these packages?
  - In some cases, technical issues for the package may abound (e.g., “signature consistency and dependency intricacies have been shown to result in errors and/or incorrect results”) and may constitute “glass ceilings” (until resolved).


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Background

Exemplar MADM/MODM SMs/OMs

#	Tools, Platforms, Methodologies, Frameworks, and Systems (TPMFS)	MADM/ MODM	SM/ OM
1	Analytic Hierarchy Process (AHP)	MADM [34]	SM [35]
2	Weighted Aggregated Sum Product Assessment (WASPAS)	MADM [36]	SM [37]
3	CRiteria Importance through Intercriteria Correlation (CRITIC)	MADM [38]	OM [39]
4	Data Envelopment Analysis (DEA)	MADM [38]	OM [38]
5	Technique of Order Preference by Similarity to an Ideal Solution (TOPSIS)	MADM [40]	OM [41]
6	Fuzzy VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR)	MADM [42]	SM/OM [43]
7	Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) (e.g., I and II)	MADM [44]	SM/OM [45][46] [47][48] [49]
8	ELimination Et Choix Traduisant la Realité (ELECTRE)	MADM [50]	SM/OM [47]
9	Multi-Objective Optimization by a Ratio Analysis plus the Full Multiplicative Form (MULTIMOORA)	MODM [51]	SM [51]
10	Goal Programming (GP) Method	MODM [52]	OM [52]

- **Multi-Criteria Decision-Making (MCDM)**
- **The counterpoising of Multi-Attribute Decision-Making (MADM) and Multi-Objective Decision-Making (MODM):**
  - The counterpoising of MADM with MODM-based approaches remains a relatively unsaturated/nascent area.
- **The counterpoising of Subjective Methods (SM) with Objective Methods (OM):**
  - The counterpoising of SM with OM-based approaches remains a relatively unsaturated/nascent area.
  - Taherdoost, Hwang & Yoon, and others note that the arena of MCDM endeavors has leveraged both SM and OM so as to formulate a more practical/logical weightings
- **The notion of counterpoising Transparency, Explainability, and Accountability (TEA) remains a challenging area, particularly for the Machine Learning (ML) on ML ecosystem.**

Extrapolated Data Quality Thematics (EDQTS) for the various Data Quality (DQ) Dimensions

DQ #	EDQTs
1	LHM (UDC/CDC)
2	HON (PIDS/NIDS)
3	DAWS
4	C2 (MCP/ECP)
5	TEA (M/A)
6	RR

- **Abbas & Howard cite 6 elements of Decision Quality (DQ):**
  - (1) an understanding of the involved "uncertainty;"
  - (2) a grasp of the problem boundaries (e.g., including the temporal constraints of (1)) and the "perspectives involved;"
  - (3) identification of the reasoning involved (e.g., "values," "trade-offs," prioritization schemas, etc.);
  - (4) the "commitment to action" by the Decision Maker (DM) "and the stakeholders…affected by the decision;"
  - (5) the determination of "feasible" alternatives;
  - (6) the "choice criterion" to "choose the alternative with the highest expected utility" (e.g., use of the Neumann-Morgenstern utility function).
- **DQs segue to Extrapolated DQ Thematics (EDQTs):**
  - (1) Lower Ambiguity Higher Uncertainty Module (LHM)
  - (2) Higher Order Networks (HON)
  - (3) Dynamic Assessment Weighting Systems (DAWS)
  - (4) Command and Control (C2)
  - (5) Transparency, Explainability, and Accountability (TEA)
  - (6) Rank Reversal (RR)

Extrapolated Data Quality Thematics (EDQTS) for the various Data Quality (DQ) Dimensions

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- **DQs segue to Extrapolated DQ Thematics (EDQTs):**
  - (1) Lower Ambiguity Higher Uncertainty Module (LHM)
  - (2) Higher Order Networks (HON)
  - (3) Dynamic Assessment Weighting Systems (DAWS)
  - (4) Command and Control (C2)
  - (5) Transparency, Explainability, and Accountability (TEA)
  - (6) Rank Reversal (RR)
- **Other Sub-Acronyms:**
  - (1) Uncompressed Decision Cycles (UDC)
    Compressed Decision Cycles (CDC)
  - (2) Positive Influence Dominating Set (PIDS)
    Negative Influence Dominating Set (NIDS)
  - (3) -
  - (4) Minimum Controllability Problem (MCP)
    Effective Controllability Problem (ECP)
  - (5) Methods (M)
    Architecture (A)
  - (6) -

Types of Rank Reversal (RR) Types (RRT)

RRT #	Initial Ranking	Expected Ranking after change	Exemplar Manifested RR
1	DEP_3,DEP_1,DEP_2	(DEP_1 ~ DEP_4); DEP_3,DEP_4,DEP_2	DEP_2,DEP_4,DEP_3
2	DEP_3,DEP_1,DEP_2	(DEP_1 > DEP_4); DEP_3,DEP_4,DEP_2	DEP_2,DEP_4,DEP_3
3	DEP_3,DEP_1,DEP_2	(DEP_1 ~ DEP_4); DEP_3 > DEP_4 DEP_4 > DEP_2; DEP_3,DEP_4,DEP_2;	DEP_3 > DEP_4 DEP_2 > DEP_4; (DEP_3 ~ DEP_2); DEP_3~DEP_2 >DEP_4
4	DEP_3,DEP_1,DEP_2	DEP_3 > DEP_4 DEP_4 > DEP_2; DEP_3 >DEP_4>DEP_2	DEP_3 > DEP_2 DEP_2 > DEP_4; DEP_3 >DEP_2>DEP_4

- **Decision Engineering Pathway (DEP)**

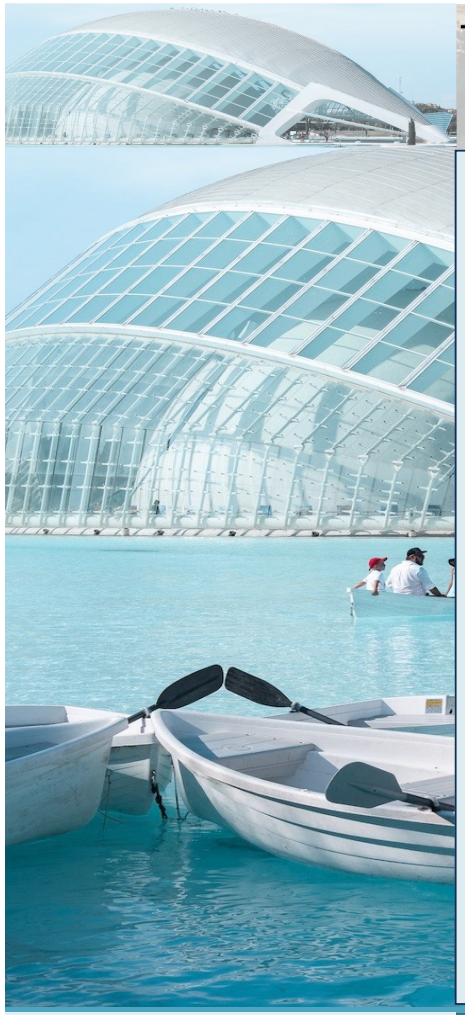
Zizovic's Ranking of Alternatives through Functional mapping of criterion sub-intervals into a Single Interval "Ranking of the Alternative in Scenario"

Alternatives	Scenarios					
	S0	S1	S2	S3	S4	S5
A5	1	1	1	1	1	1
A1	2	2	2	2	2	
A4	3	3	3	3		
A2	4	4	4			
A3	5	5				
A6	6					

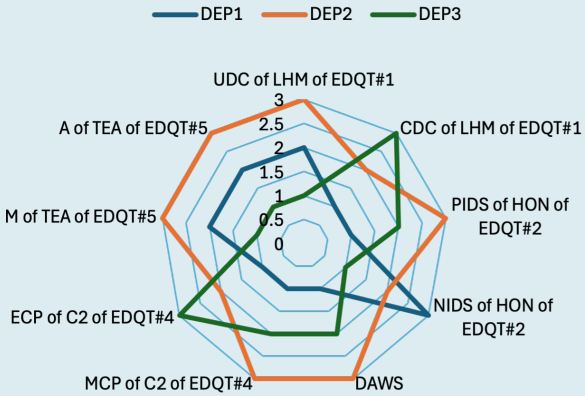
Experimentation

Application of Zizovic's RAFSI "Ranking of the Alternative in Scenario" to this paradigm of "Treatment of the Multi-Attribute Decision-Making Rank Reversal Problem for Real-World Systems"

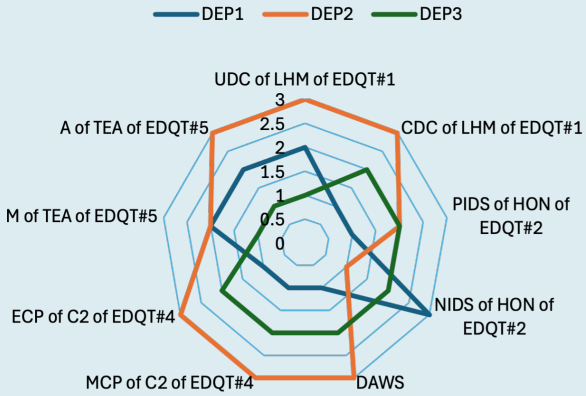
Alternatives	Scenarios					
	UDC of LHM (EDQT#1)			CDC of LHM (EDQT #1)		
	S0	S1	S2	S3	S4	S5
DEP_3	1	1	1	3	3	3
DEP_1	2	2	2	1	1	1
DEP_2	3	3	3	2	2	2



EDQT#1 to 5 for Scenario 1

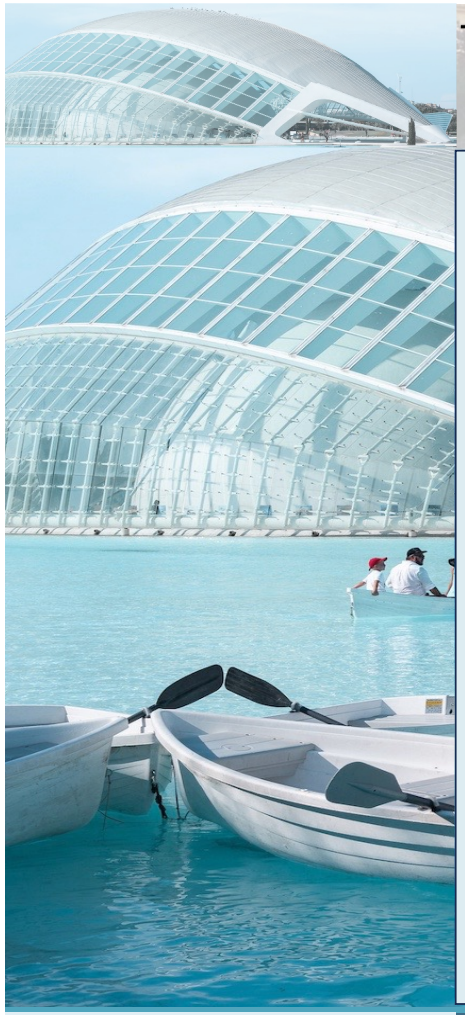


EDQT#1 to 5 for Scenario 4

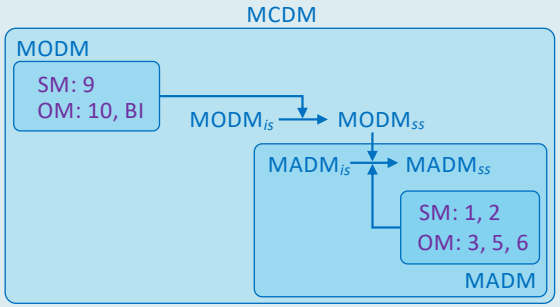


Uncompressed Decision Cycles (UDC)
Compressed Decision Cycles (CDC)
Positive Influence Dominating Set (PIDS)
Negative Influence Dominating Set (NIDS)

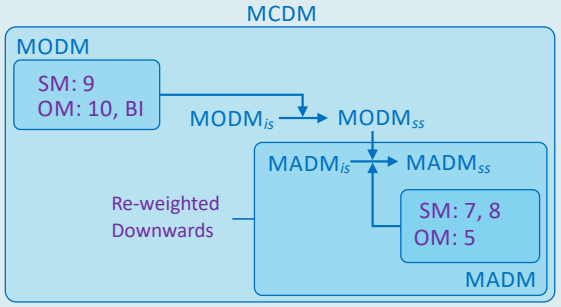
Minimum Controllability Problem (MCP)
Effective Controllability Problem (ECP)
Methods (M)
Architecture (A)



Initial paradigm, which was highly subject to RR



Experimentation for a more RR-resistant paradigm



Exemplar benchmarking for select TPMFS

TPMFS #	R/S RR	TEA	F	C	P
5					
8					
6					

Tools, Platforms, Methodologies, Frameworks, and Systems (TPMFS)
Resistance/Stability to Rank Reversal (R/S RR)
Transparency, Explainability, Accountability (TEA)
Flexibility (F)
Consistency (C)
Performance (P)

Conclusion

- **Build me an AI System (AIS)!**
- **Certain clarifications are needed; what about the data?**
  - The Data might dictate the M.
  - The M might dictate the A.
- **Certain considerations are needed; is it a local or global AIS?**
  - Will the AIS be used at the edge?
  - Will there be a training/inferencing inversion?
- **Certain aspects need to be considered; is it a Minimum Viable Product (MVP)? What about the timing?**

  Is Rapid Application Development (RAD) expected?
  - Is this a mission-critical RWS system?
  - Given RR and the like, the AIS may be non-trivial to build.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