

DICE Theory: A Decision Integrity and Completeness Evaluation Framework

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Abstract

Decision-making in complex, uncertain, and volatile environments requires not only robust cognitive processing but also structured evaluation of decision quality. While existing frameworks focus on either process (how decisions are made) or outcomes (what decisions achieve), there remains a critical gap in evaluating the integrity and completeness of decisions.

This paper introduces DICE Theory (Decision Integrity and Completeness Evaluation) as a novel evaluative construct designed to assess decision quality across four dimensions: Depth, Integration, Coherence, and Exhaustiveness.

Positioned within a broader decision intelligence architecture, DICE acts as an intermediate evaluation layer between cognitive processing models (e.g., EIARA) and quantitative measurement systems (e.g., DMQS).

The framework contributes to emerging research in decision intelligence, explainable AI (XAI), and human–AI collaboration by providing a structured mechanism to evaluate decision robustness, alignment, and completeness. DICE enables both theoretical advancement and practical application in strategic and operational decision-making contexts.

Keywords

Decision Intelligence; Decision Quality; Explainable AI; Cognitive Evaluation; MECE Principle; Human–AI Collaboration; Strategic Decision-Making

1. Introduction

Decision-making is increasingly shaped by complex interactions between human cognition, data-driven insights, and algorithmic recommendations. In such environments—often described as volatile, uncertain, complex, and ambiguous (VUCA)—the quality of decisions cannot be assessed solely based on outcomes or predictive accuracy.

Existing approaches primarily focus on:

- Cognitive processes (how decisions are formed), or
- Performance metrics (what results decisions produce)

However, there is limited emphasis on evaluating how structurally sound, integrated, and complete a decision is before execution. To address this gap, this study proposes DICE Theory, a structured evaluation framework that assesses decision integrity and completeness prior to outcome realization.

2. Conceptual Foundation of DICE Theory

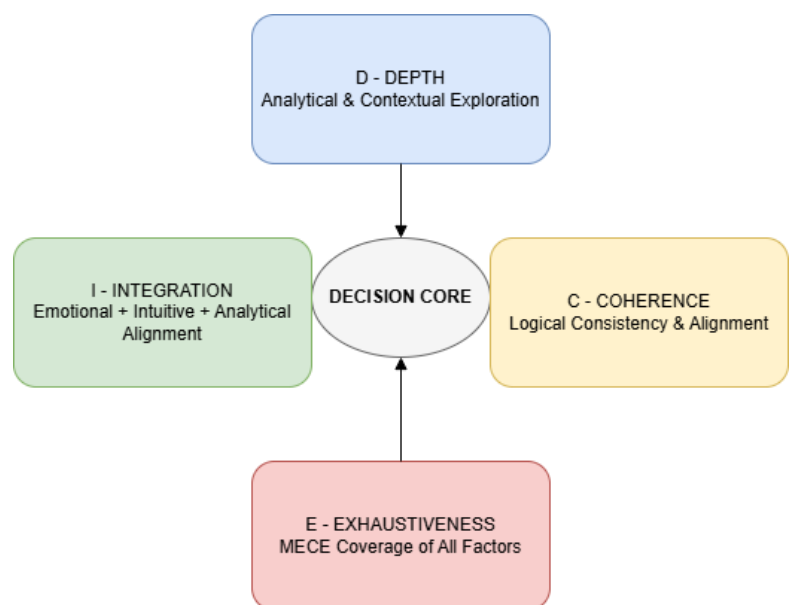
DICE Theory is conceptualised as a decision evaluation construct consisting of four interdependent dimensions.

2.1 Depth (D)

Depth refers to the extent of analytical, contextual, and exploratory rigor applied during decision-making. It captures: breadth of data exploration, consideration of alternative scenarios, and level of critical reasoning. Shallow decisions often rely on heuristics; deep decisions involve multi-layered analysis.

2.2 Integration (I)

Integration measures the alignment across different cognitive inputs, including emotional



$$\text{Decision Quality} = f(\text{Depth, Integration, Coherence, Exhaustiveness})$$

signals, intuitive judgments, and analytical reasoning. It reflects the degree to which decision components are harmonised rather than fragmented. Poor integration leads to cognitive dissonance; strong integration supports balanced decisions.

2.3 Coherence (C)

Coherence represents the internal logical consistency of the decision. It evaluates logical structure, consistency between assumptions and conclusions, and absence of contradictions. A coherent decision is logically defensible and structurally stable.

2.4 Exhaustiveness (E)

Exhaustiveness assesses whether the decision adequately covers all relevant dimensions of the problem space. It is aligned with the MECE principle (mutually exclusive, collectively exhaustive). This includes coverage of all key variables, consideration of risks and constraints, and inclusion of alternative pathways. Non-exhaustive decisions create blind spots and hidden risks.

3. Theoretical Positioning

DICE Theory is positioned within a multi-layered decision intelligence architecture.

Conceptual Stack

Layer	Function	Role
EIARA	Cognitive Process Layer	Models decision-making states
DICE	Evaluation Layer	Assesses decision integrity
DMQS	Measurement Layer	Quantifies decision quality

Flow Representation

EIARA (Process) → DICE (Evaluation) → DMQS (Measurement)

EIARA explains how decisions emerge, DICE evaluates how sound the decision is, and DMQS measures how good the decision performs.

4. Role in Decision Intelligence and XAI

DICE Theory contributes to the field of explainable AI (XAI) and decision intelligence by providing human-interpretable evaluation criteria, bridging cognitive reasoning and algorithmic outputs, and supporting trust and transparency in AI-assisted decisions. Unlike traditional AI evaluation metrics (accuracy, precision, recall), DICE focuses on the structural and cognitive quality of decisions.

5. Application Domains

DICE Theory can be applied across multiple domains, including:

- Strategic Decision-Making: business strategy, market entry decisions, investment planning.
- Operational Decision-Making: process optimisation, resource allocation, performance management.
- Human–AI Collaboration: AI-assisted recommendations, decision support systems, hybrid intelligence models.

6. Research Implications

Theoretical Contributions

- Introduces a new evaluation construct in decision science.
- Bridges process and measurement gaps.
- Aligns with interdisciplinary research (cognitive science, AI, management).

Methodological Contributions

- Can be operationalised into Likert-scale instruments.
- Supports mixed-methods research designs.
- Enables empirical validation through decision quality metrics.

7. Future Work

Future research should focus on developing validated measurement scales for DICE dimensions, empirical testing across industries (e.g., telecom SMEs, healthcare, finance), integration with AI-driven decision systems, and mapping DICE with existing theories (bounded rationality, dual-process theory, XAI frameworks).

8. Conclusion

DICE Theory provides a structured and scalable approach to evaluating decision quality through the lenses of depth, integration, coherence, and exhaustiveness. By positioning itself between cognitive processing and quantitative measurement, DICE fills a critical gap in decision science. Its integration within a broader architecture (EIARA → DICE → DMQS) enables a full-stack decision intelligence framework, supporting both theoretical advancement and real-world application in complex environments.

9. References

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