

The 22nd Economic International Conference

Challenges and Opportunities for a Sustainable Development

Stefan cel Mare University of Suceava, 2026

Strategy Meets Sustainability

How Mathematical Frameworks Can Enhance
Strategic Analysis for Sustainable Development

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Presentation Outline

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Introduction: The Problem

- Sustainability pressures are reshaping competitive landscapes, yet organizations **struggle to integrate sustainable development into strategic reasoning.**
- Strategic management remains **anchored in short-term, firm-centric paradigms** (Bansal et al., 2024; Davis & DeWitt, 2025)
- Organizational and cultural barriers are well documented, but **less attention has been given to the analytical tools themselves.**
- **Key question: Could mathematical modelling frameworks serve as enablers of sustainability integration?**

Mathematical Paradigms for Modelling Competition

Game Theory

Models competition as strategic interactions between rational actors seeking optimal outcomes

(Ramani & De Giovanni, 2026)

- Discrete interactions
- Rational players
- Payoff optimization
- Equilibrium-seeking

Systems Theory

Models competition as dynamic behaviour emerging from feedback loops and circular causality

(Weaver et al., 2025)

- Feedback loops
- Accumulations & depletion
- Delays & circular causality
- Emergent behaviour

Both have been applied to sustainability, each offering distinct analytical capabilities.
(Sedovs et al., 2025)

Research Gap and Purpose

The Gap

Less attention has been given to mathematical modelling frameworks as enablers of sustainability integration, and to how formal representations of competitive situations can make sustainability factors **visible, quantifiable, and actionable**.

Research Question

How can game-theoretic and systems-theoretic frameworks support the integration of sustainable development into strategic management?

The aim is to develop a conceptual framework demonstrating how each paradigm contributes to making sustainability an integral part of competitive strategic analysis.

Core argument: Mathematical modelling paradigms are not neutral instruments but active contributors to sustainability-oriented strategic reasoning.

Semi-structured literature review

Stream 1

Mathematical modelling of competition in strategic management
(Game Theory + Systems Theory)

Stream 2

Sustainability science and sustainability-oriented strategic management

Approach:

- Structured comparison of each paradigm's analytical capabilities
- Integration of interdisciplinary perspectives
- Development of a conceptual framework around key analytical lenses
- *Responds to calls for integrated frameworks (Weaver et al., 2025; Sedovs et al., 2025)*

Key Results: Four Analytical Lenses

Analytical Lens	Game Theory	Systems Theory
Temporality	Sequential and repeated interaction models	Continuous dynamic modelling
Causal Structure	Linear strategic reasoning	Circular causality and feedback loops
Accumulation & Depletion	Point-in-time payoff estimation	Resource stocks, environmental degradation over time
Decision Orientation	Optimal move identification	Adaptive intervention in system structure

Each paradigm captures different dimensions of sustainability-relevant competitive dynamics.

What Each Paradigm Reveals for Sustainability

Game Theory contributions:

- Strategic logic of sustainability trade-offs
- Incentive structures for cooperation vs. free-riding on environmental commitments
- Equilibrium analysis of multi-stakeholder interactions
- Formal analysis of regulatory game dynamics

Systems Theory contributions:

- Feedback loops linking firm actions to environmental consequences
- Resource stock depletion dynamics invisible to static analysis
- Delays between unsustainable practices and their competitive impact
- Tipping points and nonlinear systemic transitions

Key findings:

- The choice of mathematical paradigm has substantive consequences for whether and how sustainability factors enter strategic reasoning.
- Each paradigm makes visible what the other structurally cannot. The two paradigms are complementary.

Why does this matter?

- Game-theoretic frameworks privilege short-term optimization and discrete interactions, systematically filtering out sustainability dynamics.
- Systems-theoretic frameworks capture feedback, depletion, and delays, but lack the strategic interaction logic managers need.

Neither paradigm alone is sufficient; both are necessary.

Implications:

- **For researchers:** the analytical lens shapes what can be studied; choosing a paradigm is choosing what becomes visible.
- **For managers:** sustainability-informed strategy requires tools that capture dynamics, not just snapshots.
- **For educators:** strategic analysis curricula should expose students to both paradigms.

Conclusions

1

Mathematical modelling frameworks are not merely technical tools for competitive analysis but essential enablers of sustainability-informed strategic reasoning.

2

Game theory and systems theory offer distinct and complementary analytical capabilities for integrating sustainability into competitive strategy.

3

Shifting focus from values-based approaches toward analytical foundations opens a new path for embedding sustainability into the core of strategic decision-making.

Future research opportunity: An empirical validation with managers to test whether these representations improve sustainability-informed strategic reasoning in practice.

Selected References

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Thank you very much!

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