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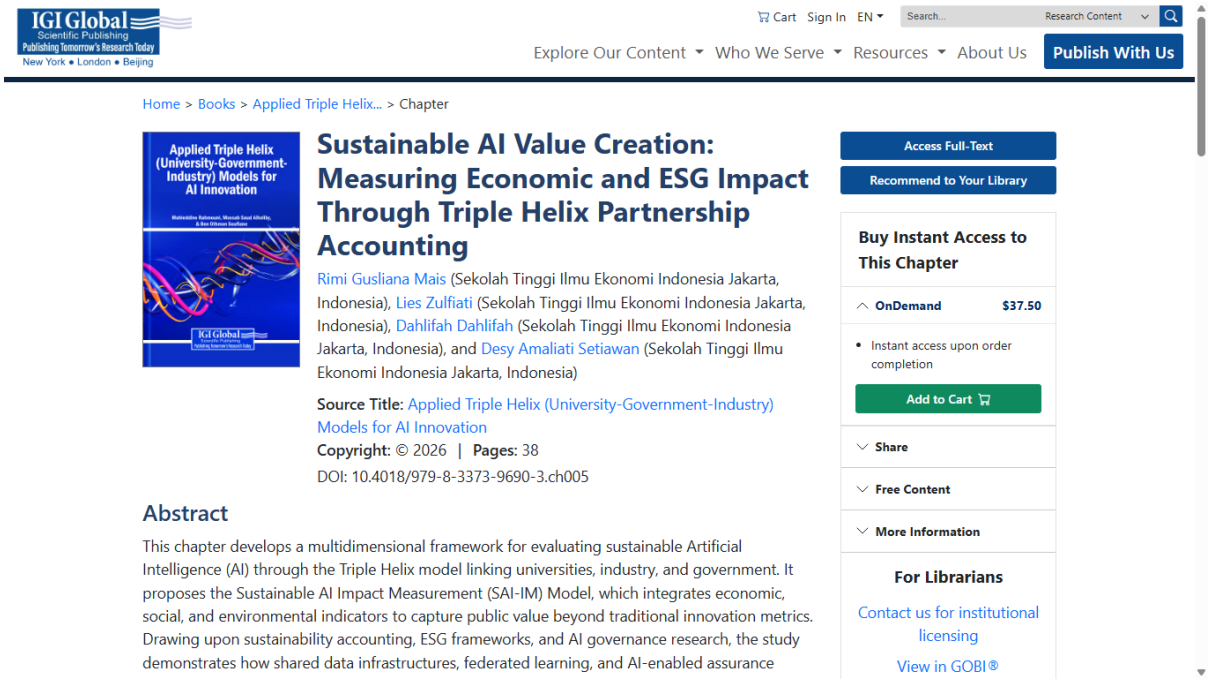

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Applied Triple Helix (University-Government-Industry) Models for AI Innovation

Sustainable AI Value Creation: Measuring Economic and ESG Impact Through Triple Helix Partnership Accounting

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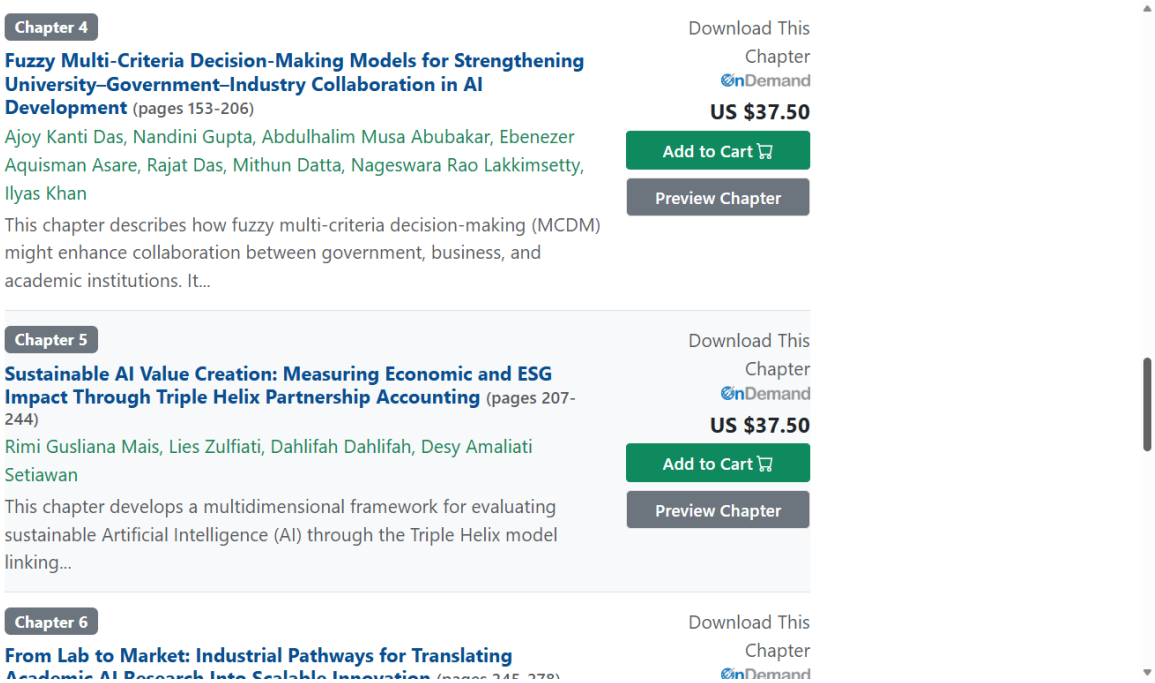
Abstract

This chapter develops a multidimensional framework for evaluating sustainable Artificial Intelligence (AI) through the Triple Helix model linking universities, industry, and government. It proposes the Sustainable AI Impact Measurement (SAI-IM) Model, which integrates economic, social, and environmental indicators to capture public value beyond traditional innovation metrics. Drawing upon sustainability accounting, ESG frameworks, and AI governance research, the study demonstrates how shared data infrastructures, federated learning, and AI-enabled assurance

CHAPTER 5



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Fuzzy Multi-Criteria Decision-Making Models for Strengthening University–Government–Industry Collaboration in AI Development (pages 153-206)
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This chapter describes how fuzzy multi-criteria decision-making (MCDM) might enhance collaboration between government, business, and academic institutions. It...
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collaborative ecosystems capable of generating socio-economic value through integrated knowledge flows. A pivotal step in this process is the identification of quantifiable variables to evaluate systemic impacts and relationships, thereby facilitating the monitoring of innovation investments. This study addresses this gap by proposing a methodological framework for a prototype designed to advance sustainable, data-driven innovation.

Chapter 3

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Modern universities have shifted from basic teaching and research to becoming drivers of economic development and AI innovation. However, resource-constrained universities (RCUs) face a "vicious cycle" where limited funding, aging infrastructure, and a lack of specialized expertise prevent them from keeping pace with rapid technological shifts. Traditional academic structures are often too slow and rigid for the AI era, leaving many institutions marginalized in global innovation networks. To address this, the text proposes a "university-nested" ecosystem to operationalize the Triple Helix (university-industry-government) model through three mechanisms (1) Industry-co-designed micro-credentials for agile skills training, (2) Interdisciplinary Research Groups for collaborative problem-solving, and (3) Centres of Excellence to scale these partnerships sustainably. This roadmap enables RCUs to transform from passive degree-providers into proactive co-architects of technological innovation.

Chapter 4

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This chapter describes how fuzzy multi-criteria decision-making (MCDM) might enhance collaboration between government, business, and academic institutions. It demonstrates why cooperation in AI development entails ambiguity and conflicting

viewpoints. Vague judgments are transformed into usable values with the use of fuzzy sets and triangular fuzzy numbers. Fuzzy numbers are used to assess various factors, including research strength, finance, policy flexibility, technology preparedness, and social impact. The shifting significance of each criterion for various partners is displayed by fuzzy weights. All viewpoints are combined into a single meaningful score using aggregation and defuzzification techniques. Fuzzy soft sets highlight areas of agreement and aid in identifying areas of disagreements between partners. Partners can select AI laboratories, internships, and ethical committees, as demonstrated by several cases. The chapter demonstrates how fuzzy models improve the clarity and fairness of collaborative judgments in AI development.

This chapter develops a multidimensional framework for evaluating sustainable Artificial Intelligence (AI) through the Triple Helix model linking universities, industry, and government. It proposes the Sustainable AI Impact Measurement (SAI-IM) Model, which integrates economic, social, and environmental indicators to capture public value beyond traditional innovation metrics. Drawing upon sustainability accounting, ESG frameworks, and AI governance research, the study demonstrates how shared data infrastructures, federated learning, and AI-enabled assurance systems strengthen transparency and accountability. Comparative analysis with Quadruple Helix and public-private partnership models reveals that hybrid, ethically grounded collaborations achieve superior legitimacy and inclusiveness. Policy implications include the adoption of standardized impact taxonomies, ESG-integrated reporting, and capacity-building initiatives to enhance institutional readiness. The chapter contributes to theory by aligning innovation governance with sustainability accounting and AI's long-term value.

The translation of academic Artificial Intelligence (AI) research into scalable industrial solutions requires coordinated pathways that link scientific discovery with commercialization. This chapter examines how universities, industries, and government agencies collaborate across technology transfer mechanisms, joint research programs, incubators, and innovation pipelines to transform AI prototypes into market-ready systems. Case studies from healthcare and smart manufacturing illustrate how access to real-world data, engineering expertise, regulatory engagement, and controlled testing environments accelerate successful deployment. The chapter also highlights key challenges, including intellectual property issues, regulatory uncertainty, data limitations, and ethical risks, and emphasizes the need for responsible governance, interdisciplinary collaboration, and ecosystem-level support. A strategic roadmap is proposed to guide institutions toward sustainable AI innovation that balances technical rigor, societal values, and market readiness.

This chapter advances a theoretical framework positioning hybrid project management as an operational enabler of Triple Helix collaborations in AI-driven transportation infrastructure. While existing literature emphasizes strategic university-government-industry partnerships, insufficient attention addresses procedural mechanisms facilitating effective knowledge transfer across institutional boundaries. Drawing from project management theory, innovation systems research, and organizational behavior scholarship, this chapter demonstrates how hybrid models—integrating predictive lifecycle structures with adaptive Agile practices—address critical friction points: knowledge translation gaps between research and implementation, regulatory-innovation tensions in government projects, and interdisciplinary coordination challenges. The Triple Helix Process Integration Model maps project management practices to knowledge exchange mechanisms, offering theoretical advancement and practical guidance for stakeholders navigating AI partnerships in regulated environments.

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