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

Rimi Gusliana Mais (Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia), Lies Zulfiati (Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia), Dahlifah Dahlifah (Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia), and Desy Amaliati Setiawan (Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia)

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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

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CHAPTER 5

Chapter 4

Fuzzy Multi-Criteria Decision-Making Models for Strengthening University-Government-Industry Collaboration in AI Development (pages 153-206)

Ajoy Kanti Das, Nandini Gupta, Abdulhalim Musa Abubakar, Ebenezer Aquisman Asare, Rajat Das, Mithun Datta, Nageswara Rao Lakkimsetty, Ilyas Khan

This chapter describes how fuzzy multi-criteria decision-making (MCDM) might enhance collaboration between government, business, and academic institutions. It...

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Preview Chapter

Chapter 5

Sustainable AI Value Creation: Measuring Economic and ESG Impact Through Triple Helix Partnership Accounting (pages 207-244)

Rimi Gusliana Mais, Lies Zulfiati, Dahlifah Dahlifah, Desy Amaliati Setiawan

This chapter develops a multidimensional framework for evaluating sustainable Artificial Intelligence (AI) through the Triple Helix model linking...

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Preview Chapter

Chapter 6

From Lab to Market: Industrial Pathways for Translating Academic AI Research into Scalable Innovation (pages 245-278)

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Detailed Table of Contents

Preface..... xi

Acknowledgement xiii

Chapter 1

Knowledge Transfer Partnerships (KTP) as a Catalyst for University–
Government–Industry Collaboration: Strengthening Innovation and Graduate
Employability..... 1

Panchalingam Suntharalingam, Birmingham City University, UK

This chapter explores Knowledge Transfer Partnerships (KTPs) in the United Kingdom as a leading model of university–government–industry collaboration that simultaneously drives innovation and enhances graduate employability. KTPs provide a structured mechanism through which academic expertise, public funding, and industry needs converge. The chapter analyses how the KTP framework embeds graduates known as Associates within organisations to deliver innovation projects supported by academic supervision and government oversight. Drawing on the principles of the Triple Helix (Government, Business, University), it evaluates the impact of KTPs on organisational competitiveness, research translation, regional development, and skills formation. The chapter positions KTPs as a scalable and internationally relevant model for strengthening innovation and preparing graduates for future labour-market demands. It argues that KTPs represent one of the most effective and mature frameworks for aligning national innovation objectives with university missions and industry talent needs.

Chapter 2

Computational Modeling of Innovation: A Quintuple Helix Simulation
Approach..... 75

*Célia M. Q. Ramos, ESGHT, CinTurs, Universidade do Algarve,
Portugal*

Quintuple Helix Innovation Theory (QHIT) conceptualizes innovation as the outcome of synergistic interactions among five key subsystems: academia, government, industry, civil society, and the natural environment. Extending beyond the Triple Helix’s focus on academia-driven growth and the Quadruple Helix’s incorporation of sustainability, the QHIT framework positions environmental sustainability as integral to long-term societal resilience, resonating with the principles of Society 5.0. Operationalizing this model necessitates the development of digitally enabled,

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

Operationalizing the Triple Helix for Resource-Constrained Universities:
A Nested Model of Micro-Credentials, Research Groups, and Centres of
Excellence 113
*Mussa Ally Dida, Nelson Mandela African Institution of Science and
Technology, Tanzania*

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

Fuzzy Multi-Criteria Decision-Making Models for Strengthening University–
Government–Industry Collaboration in AI Development 153
Ajoy Kanti Das, Tripura University, India
Nandini Gupta, Bir Bikram Memorial College, India
Abdulhalim Musa Abubakar, Modibbo Adama University, Nigeria
Ebenezer Aquisman Asare, Northeastern University, USA
Rajat Das, Tripura University, India
Mithun Datta, The ICFAI University, India
*Nageswara Rao Lakkimsetty, American University of Ras Al Khaimah,
UAE*
Ilyas Khan, Government College University, Pakistan

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.

Chapter 5

Sustainable AI Value Creation: Measuring Economic and ESG Impact
Through Triple Helix Partnership Accounting 207

Rimi Gusliana Mais, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia

Lies Zulfiati, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia

Dahlifah Dahlifah, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia

Desy Amaliati Setiawan, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta, Indonesia

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.

Chapter 6

From Lab to Market: Industrial Pathways for Translating Academic AI Research Into Scalable Innovation.....	245
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R. N. Ravikumar, Marwadi University, Rajkot, India

S. Aarathi, Marwadi University, Rajkot, India

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.

Chapter 7

Hybrid Project Management as a Triple Helix Catalyst for AI-Driven Transportation Innovation	279
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Georgios Moschoglou, Georgetown University, USA

Simon Cleveland, Purdue University Global, USA

Mak Khan, Georgetown University, USA

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.

Chapter 8

Integrating Machine Learning and AI in Smart Dairy Farms: University–Government–Industry Decision Support for Dairy Portfolio Management..... 305

K. Nafees Ahmed, Department of Computer Science, Jamal Mohamed College, Bharathidasan University, Tiruchirappalli, India

R. Srikanth, Department of Mathematics, SASHE, SASTRA University, Thanjavur, India

P. Uma Maheswari, Department of Computer Science and Business Systems, K. Ramakrishnan College of Engineering, Samayapuram, India

Subhash Kannan, Department of Computer Science and Business Systems, K. Ramakrishnan College of Engineering, Samayapuram, India

Sekar Kidambi Raju, School of Computing, SASTRA University, Thanjavur, India

The digitization of livestock farming through Artificial Intelligence (AI) and Machine Learning (ML) requires an institutional innovation ecosystem rather than isolated technologies. This study conceptualizes smart dairy farming as an outcome of Triple Helix collaboration among universities, government, and industry, resulting in an AI-based decision-support platform for dairy portfolio management. Universities advance algorithm development, governments provide regulatory and data-governance frameworks, and industry ensures practical deployment. Based on this collaboration, the study develops SynerNet, an AI model for forecasting milk production, animal health, and resource utilization. Comparative evaluation against SVM and AdaBoost shows superior performance, achieving up to 93% prediction accuracy. The findings demonstrate that coordinated university–government–industry interaction enables sustainable and transferable AI-driven agricultural innovation.

Compilation of References 339

About the Contributors 365

Index..... 371

Table of Contents

Preface	xi
Acknowledgement	xiii
Chapter 1	
Knowledge Transfer Partnerships (KTP) as a Catalyst for University– Government–Industry Collaboration: Strengthening Innovation and Graduate Employability.....	1
<i>Panchalingam Suntharalingam, Birmingham City University, UK</i>	
Chapter 2	
Computational Modeling of Innovation: A Quintuple Helix Simulation Approach.....	75
<i>Célia M. Q. Ramos, ESGHT, CinTurs, Universidade do Algarve, Portugal</i>	
Chapter 3	
Operationalizing the Triple Helix for Resource-Constrained Universities: A Nested Model of Micro-Credentials, Research Groups, and Centres of Excellence	113
<i>Mussa Ally Dida, Nelson Mandela African Institution of Science and Technology, Tanzania</i>	
Chapter 4	
Fuzzy Multi-Criteria Decision-Making Models for Strengthening University– Government–Industry Collaboration in AI Development	153
<i>Ajoy Kanti Das, Tripura University, India</i>	
<i>Nandini Gupta, Bir Bikram Memorial College, India</i>	
<i>Abdulhalim Musa Abubakar, Modibbo Adama University, Nigeria</i>	
<i>Ebenezer Aquisman Asare, Northeastern University, USA</i>	
<i>Rajat Das, Tripura University, India</i>	
<i>Mithun Datta, The ICFAI University, India</i>	
<i>Nageswara Rao Lakkimsetty, American University of Ras Al Khaimah, UAE</i>	
<i>Ilyas Khan, Government College University, Pakistan</i>	

Chapter 5

Sustainable AI Value Creation: Measuring Economic and ESG Impact
Through Triple Helix Partnership Accounting 207

*Rimi Gusliana Mais, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta,
Indonesia*

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Indonesia*

*Dahlifah Dahlifah, Sekolah Tinggi Ilmu Ekonomi Indonesia Jakarta,
Indonesia*

*Desy Amaliati Setiawan, Sekolah Tinggi Ilmu Ekonomi Indonesia
Jakarta, Indonesia*

Chapter 6

From Lab to Market: Industrial Pathways for Translating Academic AI
Research Into Scalable Innovation 245

R. N. Ravikumar, Marwadi University, Rajkot, India

S. Aarthi, Marwadi University, Rajkot, India

Chapter 7

Hybrid Project Management as a Triple Helix Catalyst for AI-Driven
Transportation Innovation 279

Georgios Moschoglou, Georgetown University, USA

Simon Cleveland, Purdue University Global, USA

Mak Khan, Georgetown University, USA

Chapter 8

Integrating Machine Learning and AI in Smart Dairy Farms: University–Government–Industry Decision Support for Dairy Portfolio Management..... 305

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Compilation of References 339

About the Contributors 365

Index..... 371