# A COMPARISON OF BIOPHARMACEUTICAL ECOSYSTEMS FROM A QUADRUPLE HELIX PERSPECTIVE: LEVERAGING AI AND LESSONS LEARNED FOR HANOI (VIETNAM).

Но

#### **AFFILIATIONS**

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#### INTRODUCTION

investigates This thesis the Biopharmaceutical Ecosystems of Leuven, Boston-Cambridge, Fukuoka, and Hanoi, focusing on their integration with Artificial Intelligence (AI). By applying the Quadruple Helix Model, the study identifies the Strengths, Weaknesses, **Opportunities**, and Threats (SWOT) of these ecosystems, providing strategic insights to enhance

### **OBJECTIVES**

- Exploration and comparison: To investigate and compare biopharmaceutical ecosystems of targeted regions through the lens of Quadruple Helix Model.
- Al Integration: Delve into Al integration and its impact on biopharmaceutical innovation and growth.
- Strategic Recommendations: Provide strategies to strengthen Hanoi's biopharmaceutical sector by learning lessons from global leaders.

#### **METHODOLOGIES**

- Comparation using SWOT Analysis: Comparing KPIs of the regions' ecosystems based on their SWOT criteria.
- Qualitative Interviews: In-depth interviews with experts



Fig. 1: The Quadruple Helix Model. (Durez, P. et al.; 2020).



## Hanoi's biopharmaceutical industry.

from regions. (378-minute interviews in total).

• **Quantitative methods:** Secondary data collection.

Fig. 2: Biopharmaceutical R&D innovation ecosystem. (Puślecki, 2021).





RESULTS/FINDINGS	KPI	Leuven, Belgium	Boston-Cambridge, USA	Fukuoka, Japan	Hanoi, Vietnam	
	R&D Investment (€ million)	389.2	7.670	N/A	N/A	
• Leuven: Strong Quadruple Helix connection and solid infrastructure.	<b>R&amp;D Expenditure in GDP%</b>	3.43	3.46	3.3	0.43	
<ul> <li>Boston-Cambridge: Substantial venture capital funding.</li> <li>Fukuoka: Strong government support.</li> </ul>	Number of Spin-offs	156	600	45	N/A	
<ul> <li>Hanoi: Emerging potential.</li> <li>Leuven: Limited venture capital funding.</li> <li>Boston-Cambridge: High operational costs.</li> <li>Fukuoka: Limited Al integration.</li> <li>Hanoi: Limited R&amp;D funding.</li> <li>Leuven: Deepen Al integration.</li> <li>Boston-Cambridge: International collaboration.</li> <li>Eukuoka: Applying Al integration</li> </ul>	Number of Patents (granted in 2023)	163	1900	264	22	
	Collaboration (Quadruple Helix Model)	Strong	Strong	Moderate	Weak	
	Al Integration Level	Advanced	Advanced	Developing	Limited	
	Talent Pool Quality	Highly skilled	Highly skilled	Skilled	Emerging	
	Government Support	Strong	Strong	Strong	Weak	
<ul> <li>Hanoi: Enhance collaboration, young talent pool.</li> </ul>	Regulation	Supportive	Supportive	Supportive	Supportive	
<ul> <li>Leuven: International competition, regulatory complexities.</li> <li>Boston-Cambridge: Intense regional competition.</li> <li>Fukuoka: Talent recruitment challenges, slow AI adaptation.</li> <li>Hanoi: Regulatory hurdles, lack of AI integration.</li> </ul>	Infrastructure	Supportive	Supportive	Supportive	Evolving	
	Financial Support and Incentives	Adequate	Abundant	Moderate	Insufficient	
	Technological Drivers	Strong	Strong	Moderate	Weak	
	Social Drivers	Strong	Strong	Moderate	Weak	
	Economic Drivers	Strong	Strong	Moderate	Weak	
	Collaborative Drivers	Strong	Strong	Moderate	Weak	
	Regulatory Barriers	Minimal	Minimal	Moderate	High	
	Technical Barriers	Minimal	Minimal	Moderate	High	
	Economic Barriers	Minimal	Minimal	Moderate	High	
	Social Barriers	Minimal	Minimal	Moderate	High	
Fig. 3: Strategic recommendations for Hanoi.	Fig. 3: Strategic recommendations for Hanoi. Table 1: The Compa			arison of KPIs in 4 regions.		
<ul> <li>CONCLUSIONS</li> <li>Examined biopharma ecosystems in Hanoi, Leuven, Boston-Cambridge, and</li> <li>Applied SWOT analysis using the Quadruple Helix Model.</li> <li>Provided strategic recommendations for Hanoi based on successful practice</li> </ul>	Fukuoka. es from other regions.		Authors: (	Quoc Huy	Phan	



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