

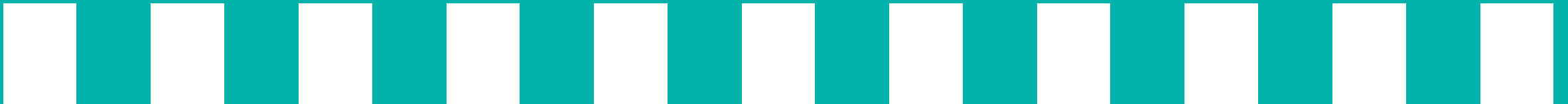
Mario Miozza

- Ph.D. candidate in Management at **Luiss University** - *(Oct 2020-Jun 2024)*
- Postdoctoral Researcher – **Alma Mater Studiorum Bologna**- *(Jun 2024-ongoing)*
- Research Consultant on Digital Transformation Projects with **Merck** (Pharmaceutical Company, 2 Years) and **ITA AIRWAYS** (Airline Company, 1 Year) - *(Jan 2022 to June 2024)*
- Visiting Researcher at **RIS Centre** (Delhi, India) and **Paris School of Business** (Paris, France) - *(Oct 2023 to July 2024)*
- **3 works published** in IEEE TEM, in Technological Forecasting and Social Change and one Book Chapter



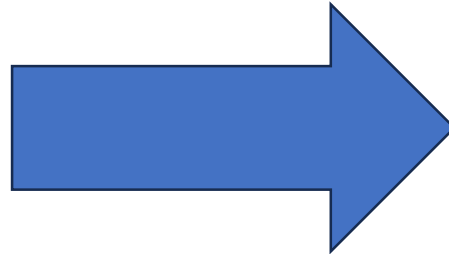
Untapping the Role of AI for SDG and Economic Performance: Empirical Evidence from the Pharmaceutical Industry

(Under Review, Technovation)



What makes PI a unique context to study DT?

- Heavily regulated and quality control based
- Low paces of DT compared with other Manufacturing Industries (E.g. Automotive)
- After Covid Pharma has shifted towards DT
- Under-researched Phenomena in Management Studies



- **I conducted an extensive SLR** to frame and address the PI-DT Future Research Agenda in Management Studies (Miozza et al., 2024).
- This work provided the **literature basis** for the one I will present today



Literature Gap (1): Research Agenda highlights the need for more studies:

1. **Addressing the Lack of Strategic Guidance and Organizational Readiness to DT → Organization**
(Satwekar et al. 2022; Alharthi, Cerotti, and Far 2020; M. Sharma et al. 2022; Kulkov 2021; Aquino et al. 2018)
2. **Investigating the individual and social factors influencing Technology Acceptance and Adoption → Individuals**
(Saha et al. 2022; Silva et al. 2020; Aquino et al. 2018; Ding 2018; Denicolai and Previtali 2020; Arief et al. 2022; Al-Shura et al. 2018; Zulfiqar et al. 2022; Liu et al. 2021; Ghadge et al. 2022; Argiyantari, Simatupang, and Basri 2020; Solfa 2022; Alharthi, Cerotti, and Far 2020; Liu et al. 2021; Argiyantari, Simatupang, and Basri 2020)
3. **Integrating DT, Economic, Social and Environmental Spheres → Sustainability**
(Chen et al. 2020; Aquino et al. 2018; Ding 2018; Nguyen et al. 2022; Shamsuzzoha, Ndzibah, and Kettunen 2020; M. Sharma et al. 2022; Ghadge et al. 2022; Zakari et al. 2022; Hosseini Bamakan et al. 2021; Ding 2018; M. Sharma et al. 2022; Burrichter, Chen, and Marco 2022; M. Sharma et al. 2023; Ertz, Centobelli, and Cerchione 2022; Junaid et al. 2023)
4. **Exploring how DT can bridge SDG performance → UN principles**
(Saha et al. 2022; Ding 2018; M. Sharma et al. 2022; Chen et al. 2020; Aquino et al. 2018; Ding 2018; Nguyen et al. 2022; Shamsuzzoha, Ndzibah, and Kettunen 2020; M. Sharma et al. 2022; Ghadge et al. 2022; Zakari et al. 2022; Hosseini Bamakan et al. 2021; Ding 2018; M. Sharma et al. 2022; Burrichter, Chen, and Marco 2022; M. Sharma et al. 2023; Ertz, Centobelli, and Cerchione 2022; Junaid et al. 2023)

AI as a pivotal technology to cover the above gaps

Literature Gap (2): "AI is a Cognitive, Socio-Technical System"

- Increasing topic of Discussion in different fields (E.g.: *Marketing, Organizational Theory, Strategic Management*) with different Empirical Lenses (*Organizations, Individuals or Society*)
- AI is one of the most invading Technologies in terms of Decision-making (Anderson, 2003; Dwivedi et al., 2021; Schneider & Leyer, 2019; Tversky & Shafir, 1992) and many research questions shall be opened to facilitate coexistence with final users (Duan, 2019) (E.g.: Explainability of AI reasoning, AI as a Job Replacement etc...) and how the organization should facilitate this integration process (e.g. Kulkov, 2021)
- Considering AI capacity to support DM for Sustainability Performance (Nishant et al., 2020) and that few studies have addressed how it relates with SDG, we aim to address the **following RQs:**

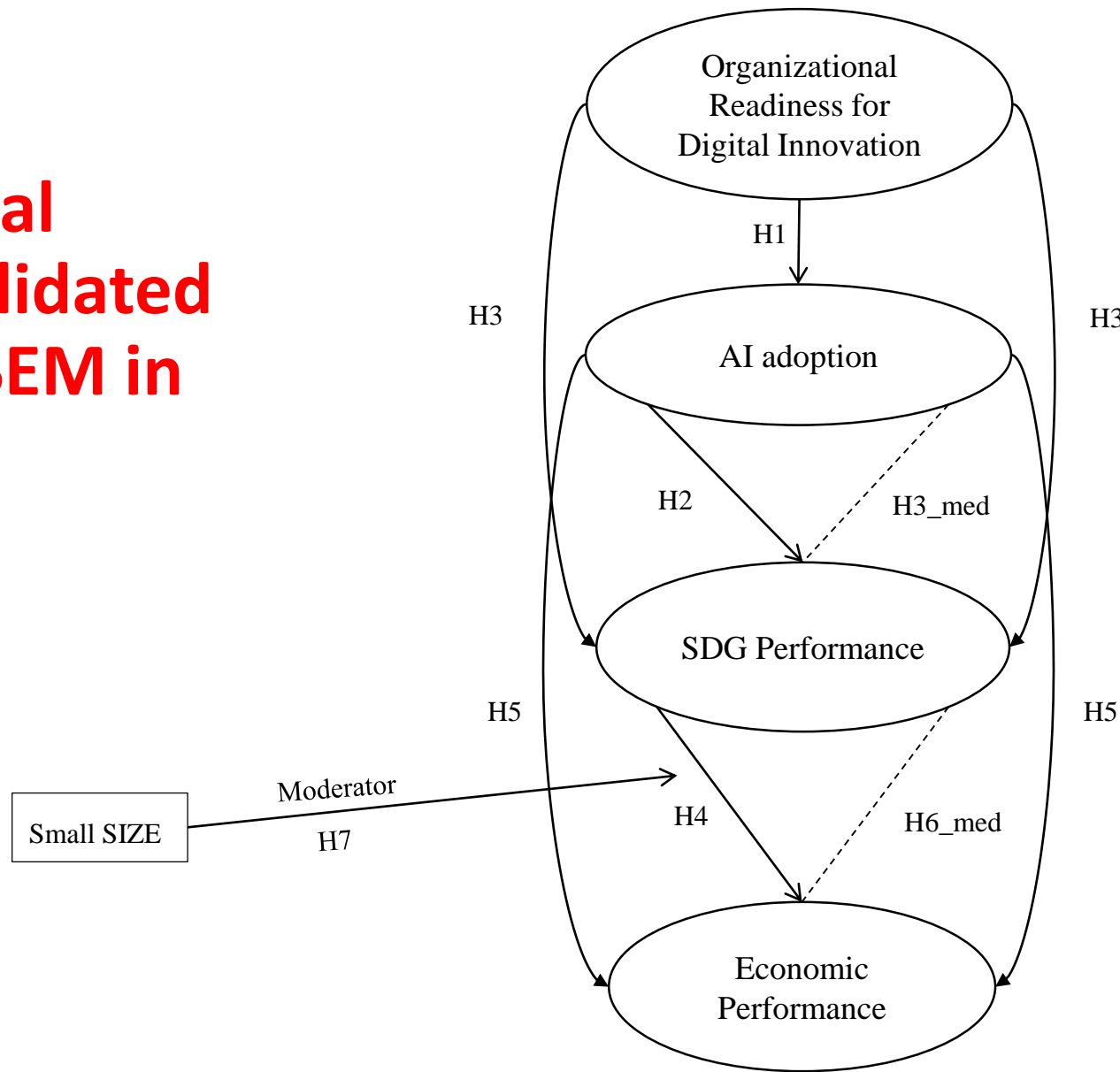
RQ1: *What are the organizational requirements facilitating AI adoption and SDG performance?*

RQ2: *What is the role of AI adoption in engaging SDG?*

RQ3: *Does engaging SDG provide benefits in terms of Economic Performance?*



Conceptual Model validated through SEM in Lisrel



Org Readiness and AI Adoption are operationalized in different constructs, coherently to the literature

Relevant Constructs

- **Strategic Readiness to Digital Innovation**
- **Cognitive Readiness to Digital Innovation**
- **Behavioral intention to use AI**
- **Social Influence to Use AI**
- **Effort Expectancy to use AI**
- **Performance Expectancy to use AI**
- **SDG Performance**
- **Economic Performance**



Higher investments for New talent and Skills, Enhanced Awareness towards DT, Long-term oriented investments in infrastructure (Lokuge et al., 2019)



Being able to facilitate final users towards AI deployment traducing Long Terms Objectives into success (Venkatesh et al., 2003, 2012, 2022)



To understand whether the relation between the previous components brings to improving SDG and Economic Performance; (Latifi et al. 2019) + Interviews on AI and SDGs



Data Collection and Measures



Measurement Scale Development

Ai Adoption: Venkatesh et al. (2003, 2012, 2022); Organizational Readiness: Lokuge et al., (2019); Economic Performance: Latifi et al., (2021)



AI-SDG Questionnaire Items

Based on 16 interviews with Pharma Industry Practitioners (SDG 3, 9, 12, 17)



Sample

511 responses from Pharma experts and Practitioners collected through the “Prolific” Platform

Measurement Model: Validity and Reliability

- EFA: Variance of 72,62%, accounting for 8 factors out of 22 without significant cross-loadings (> 0.4)
- Cronbach Alpha Items were found all significant in defining their constructs (> 0.8) and Composite Reliability Measures were found all > 0.78
- Convergent Validity (all AVE >0.5) and Discriminant Validity: *Fornell and Larcker cor.*
$$\text{AVE } \xi_1 > \phi_{21}^2$$
$$\text{AVE } \xi_2 > \phi_{21}^2$$
validated

Structural Model: Fit Indexes

χ^2 (degrees of freedom) = 347.051 (183)

Global Fit Index (GFI) = 0.942; ($>.90$)

Adjusted Goodness of Fit Index (AGFI) = 0.920; ($>.90$)

Comparative Fit Index (CFI) = 0.992; ($>.90$)

Root Mean Square Error Of Approximation (RMSEA) = 0.0415; ($>.09$)

P-Value for Test of Close Fit (RMSEA < 0.05) = 0.982; ($>.05$)

Standardized RMR = 0.0375 ($>.05$)

**The Scale is
Reliable and
Valid!**



Main Results

1. Organizational Readiness positively influences AI adoption;
2. AI adoption does not positively influence SDG performance, but mediates the positive effect between Organizational Readiness and SDG performance;
3. SDG performance positively influences Economic Performance;
4. SDG performance mediates the positive effect between AI adoption & Economic Performance, meaning that AI adoption increase economic performance because there is a commitment to achieving the SDGs.
5. Smaller Companies moderate SDG and Economic Performance effect

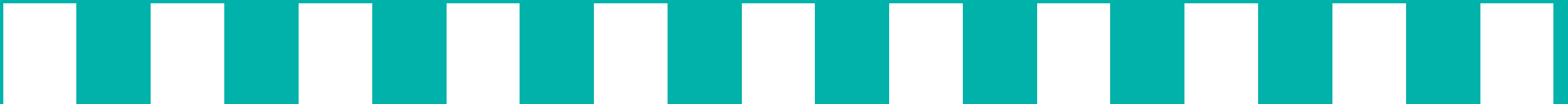


Theoretical Contributions

- Strategic and Cognitive Readiness for Digital Innovation to improve AI adoption among final users and SDG Performance (Lokuge et al., 2019, Venkatesh 2022; Cao et al. 2021; Gupta et al., 2021; Vinuesa et al., 2020)
- AI adoption increases Economic Performance, because of enhanced SDG performance (Gupta et al., 2021; Vinuesa et al., 2020)
- Companies retaining Strategic and Cognitive Readiness for Digital Innovation through effective AI adoption retain a positive Relation between SDG and Economic Performance (Lokuge et al., 2019, Venkatesh 2022; Cao et al. 2021; Gupta et al., 2021; Vinuesa et al., 2020)
- **Moderator: the less the lean** → The hypothesized model is more effective for smaller companies, because of their lighter organizational structures



Proposed Research at Masaryk University



Digital Transformation and Sustainability: an evolutionary approach



- These disrupting changes spark the curiosity of management researchers (e.g. Guandalini 2022; Feroz et al 2021) to understand what is the best combination for long-term survival.
- **Research focus:** Sustainable Business Model under Stakeholder Theory View

Literature Gaps of present BM frameworks:

- Lack of clarity regarding integrating digital technologies with specific organizational processes and industries (Chen & Tian, 2022; Lis et al., 2023; Matt et al., 2015; Vial, 2019)
- Often overlook the needs of different stakeholders involved in the DT process (Matt et al., 2015; Verhoef et al., 2021; Satwekar et al., 2022, Chen & Tian, 2022) inadequately emphasizing the importance of aligning technology impacts with the diverse needs of stakeholders (Ghosh et al., 2022; Kindermann et al., 2022; Tekic & Koroteev, 2019).
- Lack of empirical evidence regarding the factors influencing BM changes for Stakeholder's engagement arising from DT (Kindermann et al., 2022a; Peruchi et al., 2022)
- Lack of granularity in detailing on transitioning between different phases of DT while considering the needs of various stakeholders (Tekic & Koroteev, 2019; Verhoef et al., 2021; Satwekar et al., 2022).



Research Questions

RQ1: Which BM components determine a company's survival while approaching DT and ST? (**Paper 1**)

RQ2: What are the contextual and organizational dominant drivers that determine a company's survival? (**Paper 2**)

Hypothesized Methodology

Paper 1 → SEM Analysis, Data Collection in "Prolific" on a Sample of selected Manufacturing Companies (from different industries, to test moderation effects)

Paper 2 → Multiple Case Study Analysis on a Sample of selected Companies (Cross Industry and/or Cross Country Analyses e.g. "Czech Automotive Industry vs Italian Pharma Industry")

Expected Results

Paper 1 → Determining the effect of Sustainable Business Model components (E.g. Value capturing, Value Creation and Value Proposition) on different performance measures (e.g. Financial Performance, Plastic Reduction, Energy Efficiency), addressing the underlying organizational and Individual antecedents

Paper 2 → Creation of a BM framework oriented on the intersection of DT-ST (Cross Industry + Cross Country Analysis e.g. Czech Automotive Industry vs Italian Pharma Industry)



Possible Cooperation at Masaryk University

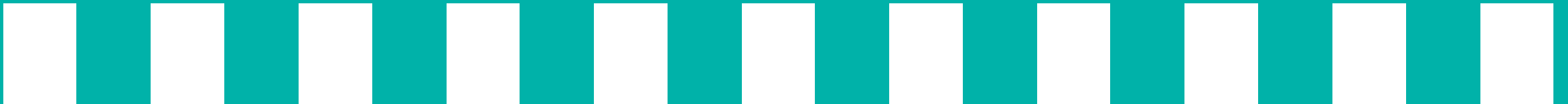
- A Klapalová → Sustainability
- R Škapa – Supply Chain
- G Vaceková → Sustainability

Potential Network in Automotive Sector?

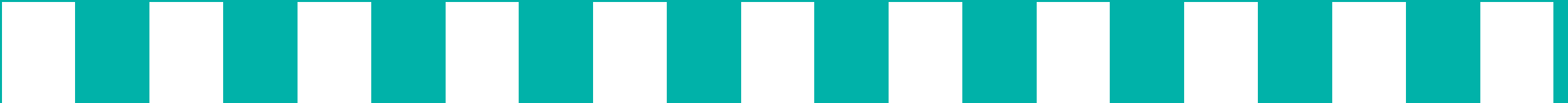
Paper: *Pain points and challenges of core return management among German and French automotive aftermarket companies* - *European Journal of International Management*, 2024



**Thanks for your
attention**



Back up Slides



Luiss

Libera Università Internazionale
degli Studi Sociali Guido Carli

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(Under Review, Technovation)

LUISS



Ph.D. Candidate – *Mario Miozza*



Theoretical Background

- A **Business Model** is defined as «Firm's architecture mechanisms for **creating, proposing** and **capturing** Value to and from **customers**.» (Zott & Amit, 2007)

(I) BM is composed by three elements: *Value Creation, Value Proposition, Value Capturing*

(II) BM aims to Create, Propose and Capture Value *from and to Customers*

This is a very limited perspective that does not consider all the relevant direct and indirect impacts involved with a company's stakeholders.

- Geissdoerfer, et al., (2018) defined a **Sustainable Business Model** as “a BM that incorporates proactive multistakeholder management, the creation of monetary and non-monetary **value** for a broad range of **stakeholders** and holds a long-term perspective.”

By definition, SBM engages and includes Stakeholders; therefore, by analyzing SBM arising from DT and Sustainability decisions, we will be able to address the following research Gaps:



Validation through SEM - Hypotheses

- H1: Organizational Readiness for Digital Innovation positively influences AI adoption
- H2: AI adoption positively influences SDG Performance
- H3: Organizational Readiness for Digital Innovation positively influences SDG Performance through the mediating effect of AI adoption
- H4: SDG performance positively influences Economic performance.
- H5: AI adoption positively influences Economic Performance
- H6: AI adoption positively influences Economic performance through the mediating effect of enhanced SDG Performance



Data Collection and Measures (2): What is the link between AI and SDG in Pharma?

1. **"Good Health and Well Being", SDG 3** → Interviews addressed AI to contribute to "Good Health and Well Being" by speeding the Drug Development Phase, and consequently improving the availability of new treatments
2. **"Responsible Consumption and Production", SDG 9** → Interviews addressed AI as relevant to enhance Decision Making to reduce environmental impact, such as proposing informed suggestions for responsible waste management
3. **"Industry, innovation and infrastructure ", SDG 12** → Interviews addressed AI to generally disrupt the whole Pharma Value Chain from Drug Discovery to Market Access
4. **"Partnership for the Goals", SDG 17** → Interviewees addressed the importance of new collaborations to deploy AI technologies and consequently address global issues such as access to medicines, shared research, and the promotion of sustainable solutions



Questionnaire Development

1. **Organizational Readiness for Digital Innovation** → ***Lokuge, Sachithra, et al., 2019***
"Organizational readiness : Development and empirical calibration of a construct." Information & management 56.3 (2019): 445-461.
2. **AI adoption** → **Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003).** User acceptance of information technology: Toward a unified view. *MIS Quarterly: Management Information Systems*, 27(3), 425–478.
3. **AI and SDG links in Pharma Industry** → ***16 Interviews with Pharma Practitioners***
4. **Economic Indicators** → ***Latifi et al., 2021*** "Business model innovation and firm performance: Exploring causal mechanisms in SMEs." *Technovation* 107 (2021): 102274.



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P-Value for Test of Close Fit (RMSEA < 0.05) = 0.982; (>.05)

Standardized RMR = 0.0375 (>.05)



The Hypothesized Model fits the dataset

Measurement Model (1): Reliability

Exploratory Factor Analysis (EFA)

- **Aim:** To identify the smallest amount of factors summarizing the original set of Items, retaining higher levels of Variance
- **Technique and Software:** Maximum Likelihood Analysis with PROMAX rotation in SPSS
- **Results:** Variance of 72,62%, accounting for 8 factors out of 22 without significant cross-loadings (> 0.4)

Construct Reliability

- **Aim:** To address each item's coherence in defining a specific construct
- **Technique and Software:** Cronbach Alpha in SPSS and Compose Reliability in Lisrel
- **Results:** Alpha Items were found all significant in defining their constructs (> 0.8) Compose Reliability Measures were found all > 0.78

**The Scale is
Reliable!**



Measurement Model (2): Validity

Confirmatory Factor Analysis (CFA)

- **Aim:** To understand the degree of consistency between items of the same construct (Convergent Validity) and how they differ from items of different constructs (Discriminant Validity)
- **Technique and Software:** Average Variance Extracted (AVE) in Lisrel
- **Results:** Convergent Validity (all AVE>0.5) and Discriminant Validity: *Fornell and Larcker co*

$$AVE \xi_1 > \phi_{21}^2$$

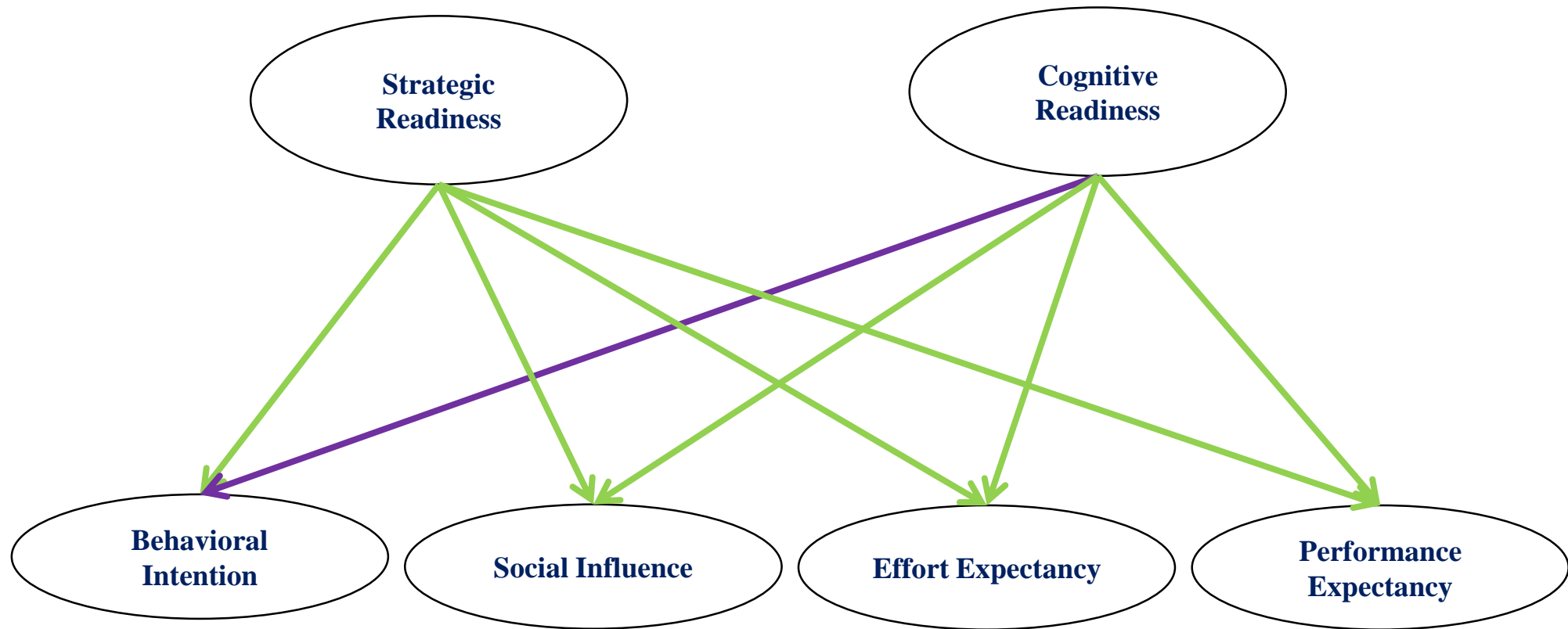
$$AVE \xi_2 > \phi_{21}^2$$

validated
Correlation Matrix

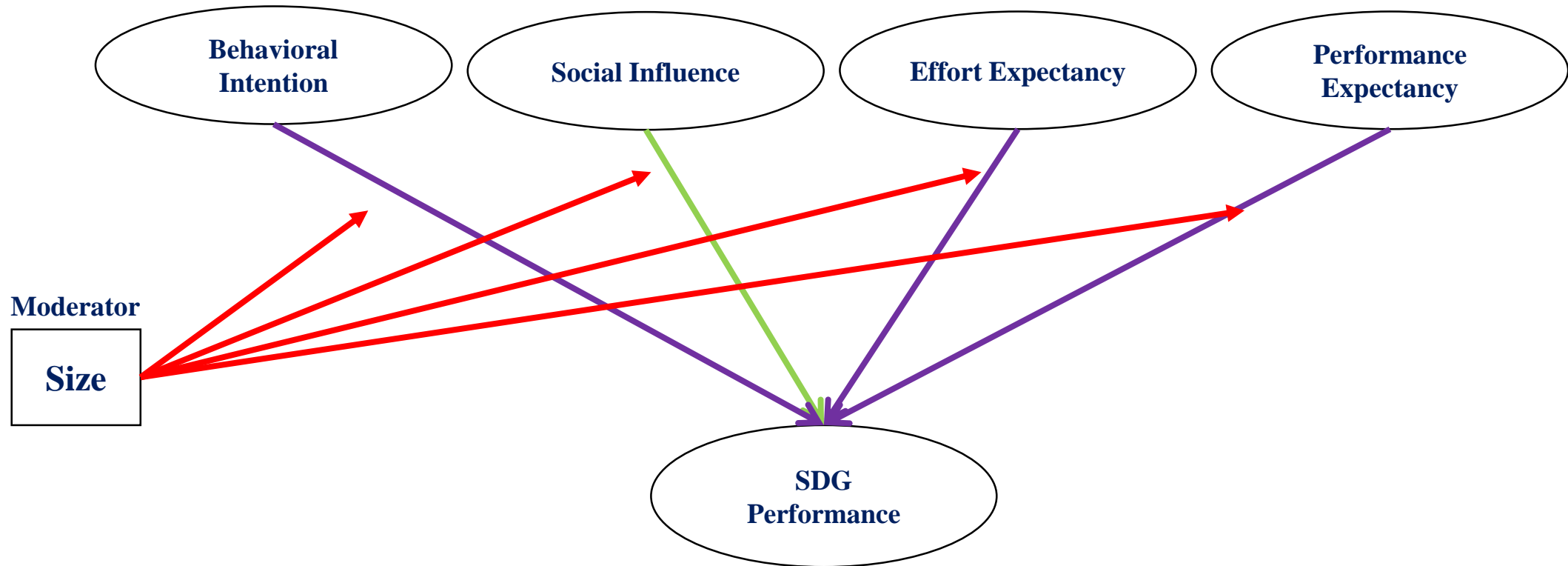
	ECP	SDG	BINT	SI	EXP	PEXP	SREAD	COG
ECP	1.000							
SDG	0.497	1.000						
BINT	0.510	0.457	1.000					
SI	0.528	0.554	0.607	1.000				
EXP	0.413	0.446	0.444	0.458	1.000			
PEXP	0.548	0.435	0.743	0.641	0.547	1.000		
SREAD	0.481	0.687	0.548	0.641	0.467	0.571	1.000	
COG	0.430	0.626	0.446	0.581	0.543	0.483	0.719	1.000

The Scale is Valid!

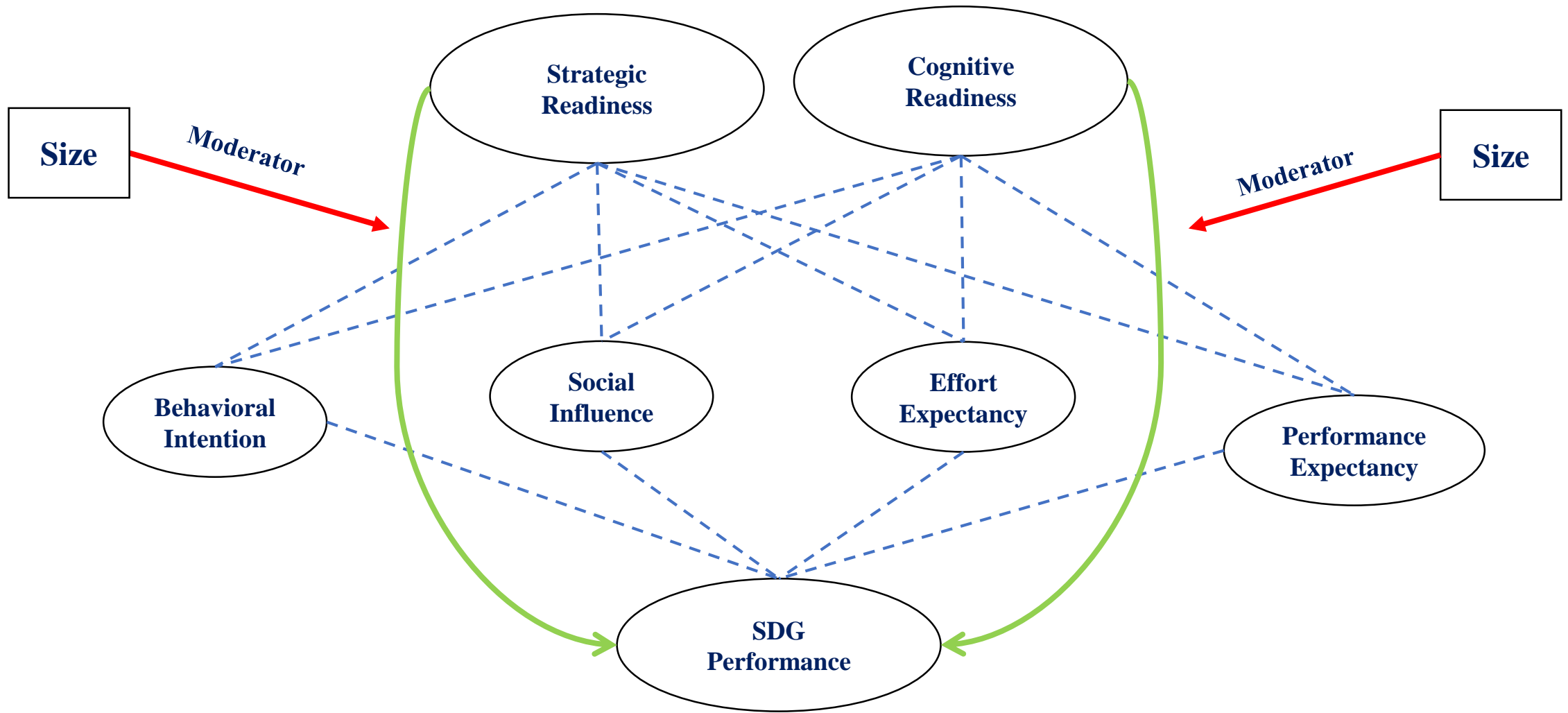
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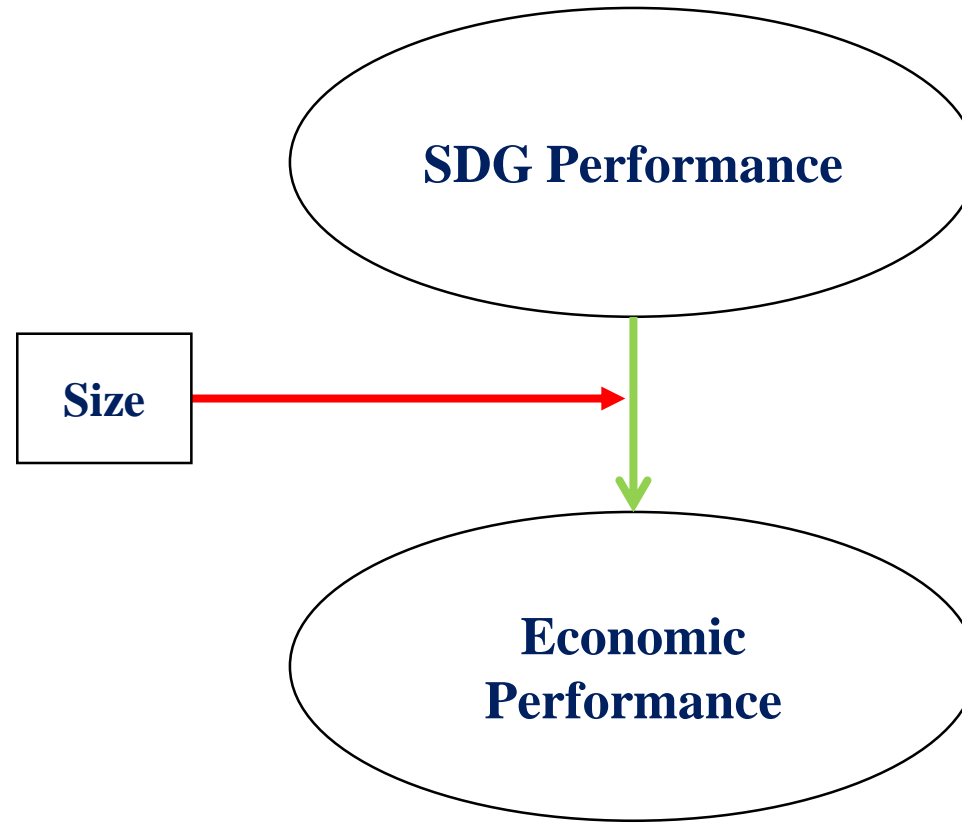
H2: AI adoption positively influences SDG Performance



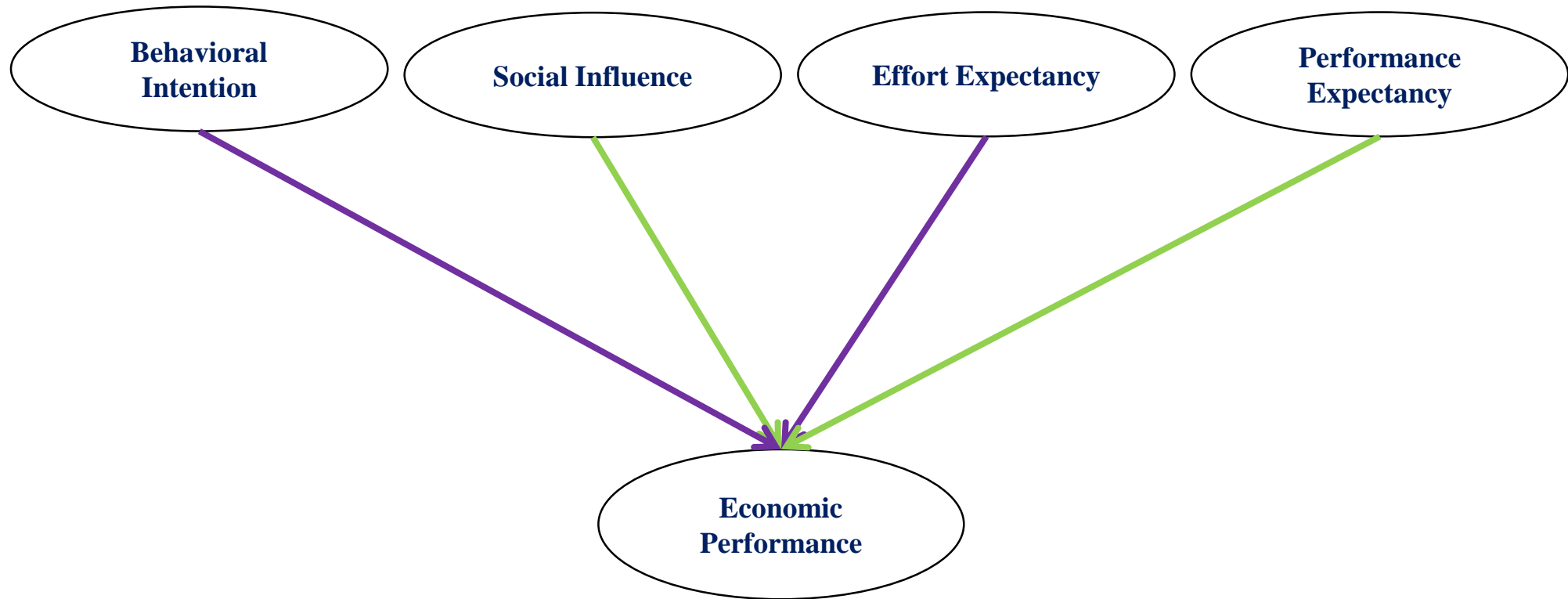
H3: Strategic and Cognitive Readiness positively influences SDG Performance through the mediating effect of AI adoption



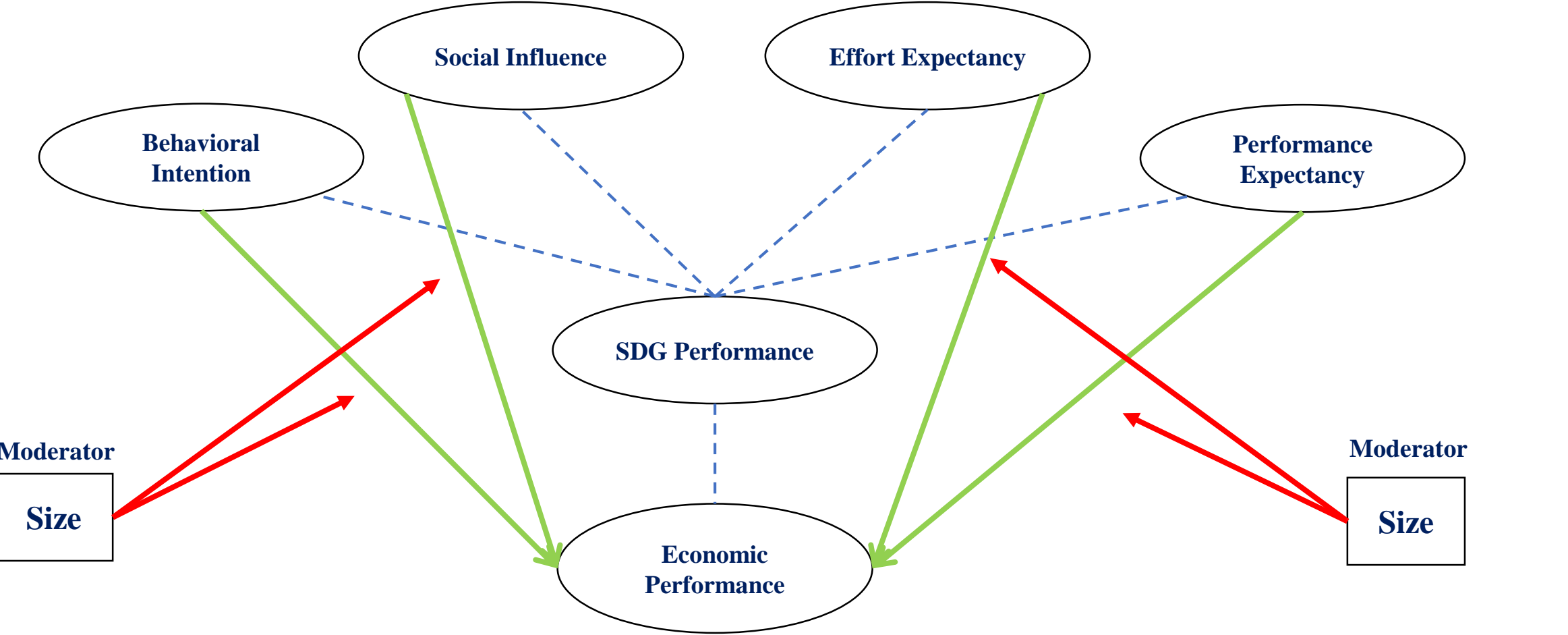
H4: SDG performance positively influences Economic performance.



H5: AI adoption positively influences Economic Performance



H6: AI adoption positively influences Economic performance through the mediating effect of enhanced SDG Performance.



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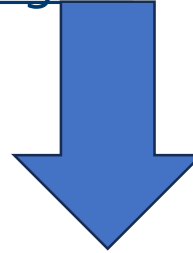
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COG	0.430	0.626	0.446	0.581	0.543	0.483	0.719	1.000

The Scale is Valid!

General lack of clarity in PI-DT Academic debate

The majority of related articles have been:

- (1) published primarily in Technical or Scientific Journals (e.g. Hariry, Barenji, and Paradkar 2022);
- (2) generally settled in the broader Healthcare context (e.g. Kraus et al. 2021);
- (3) focused either on individual technologies or single Value Chain Phases (e.g. Harrer et al. 2019)



An SLR was conducted to frame the overall Ph.D. thesis and address the PI-DT Future Research Agenda in Management Studies.



Ph.D. Thesis on Pharma Industry (PI) Digital Transformation

- **Paper 1:** (*R&R, Technological Forecasting and Social Change Journal*) → **Systematic Literature Review**
- **Paper 2:** (Under Review, *IEEE TEM Journal*) → **Systematic Literature Review**
- **Paper 3:** (Accepted at EURAM Conference, Target: *The Journal of Strategic Information Systems*) → **Qualitative Analysis**
- ~~**Paper 4:** (Accepted at DTS Conference, Target: *Technovation*) → **Quantitative Analysis**~~
- **Paper 5:** *Triad of Digital Transformation: Holistic Orchestration for People, Process, and Technology* (Recently Published in *IEEE TEM*) → **Qualitative Analysis**



Managerial Contributions



Hypotheses

H1: Strategic and Cognitive Readiness positively influences AI adoption .

H2: AI adoption positively influences SDG Performance.

H3: Strategic and Cognitive Readiness positively influences SDG Performance through the mediating effect of AI adoption .

H4: SDG performance positively influences Economic performance.

H5: AI adoption positively influences Economic performance

H6: AI adoption positively influences Economic performance through the mediating effect of enhanced SDG Performance.



Research Agenda

Aggregated Area	Research Topic	Possible Related Technologies	Value Chain	Literature	Research Questions
Cultural Change and Technology Acceptance (Organization’s Theory)	Organizational Communication and Learning	IoT,Cloud,Big Data,Blockchain,AI, Robots, 3D, AR, VR, Digital Twins	DD, CT, MK, SC, MA	Saha et al. 2022; Silva et al. 2020; Aquino et al. 2018; Ding 2018; Denicolai and Previtali 2020; Arief et al. 2022; Al-Shura et al. 2018; Zulfiqar et al. 2022; Liu et al. 2021; Ghadge et al. 2022; Argiyantari, Simatupang, and Basri 2020; Solfa 2022; Alharthi, Cerotti, and Far 2020; Liu et al. 2021; Argiyantari, Simatupang, and Basri 2020	<ul style="list-style-type: none">What are the key cultural and individual’s barriers and challenges that organizations face when implementing digital technologies?How can organizations effectively communicate the purpose and benefits of the digital transformation to employees across different phases of the pharmaceutical value chain and drive cultural change and technology acceptance?How do cultural differences across geographies and functional areas within the pharmaceutical industry influence the digital transformation process, cultural change, and technology acceptance? How can organizations effectively manage these differences?How can organizations measure and assess the progress and impact of cultural change initiatives during the digital transformation of the pharmaceutical industry, and what are the key indicators of successful cultural change in this context?
Environmental (Stakeholders Theory)	Environmental Footprint	Digital Twins, AR, VR, Cloud, 3D, Big Data, AI, Blockchain	MK, SC, MA	Chen et al. 2020; Aquino et al. 2018; Ding 2018; Nguyen et al. 2022; Shamsuzzoha, Ndzibah, and Kettunen 2020; M. Sharma et al. 2022; Ghadge et al. 2022; Zakari et al. 2022; Hosseini Bamakan et al. 2021; Ding 2018; M. Sharma et al. 2022; Burrichter, Chen, and Marco 2022; M. Sharma et al. 2023; Ertz, Centobelli, and Cerchione 2022; Junaid et al. 2023	<ul style="list-style-type: none">How can the concept of circular economy be integrated into the pharmaceutical value chain to promote resource efficiency, waste reduction, and the reuse or recycling of materials?What role can AI play in optimizing material usage and minimizing waste generation in pharmaceutical manufacturing?In what ways can 3D printing technology be leveraged to reduce waste, enable on-demand manufacturing, and enhance the overall environmental performance of pharmaceutical production?
Scalability (Strategic Management Research)	Lack of Strategic Guidance over digital innovation	IoT,Cloud,Big Data,Blockchain,AI,Robots, 3D, AR, VR	DD, CT, MK, SC, MA	Satwekar et al. 2022; Kulkov 2021	<ul style="list-style-type: none">What are the mechanisms and frameworks for assessing the potential impact and scalability of digital innovation initiatives in the pharmaceutical industry, and how can companies evaluate and prioritize investment opportunities to ensure strategic alignment and long-term competitive advantage?
Sustainability Certifications (Integration with UN’s SDGs Goals) (Stakeholders Theory)	Environmental	3D, IoT, Cloud, Blockchain, AI, Big Data	MK, SC	Saha et al. 2022; Ding 2018; M. Sharma et al. 2022	<ul style="list-style-type: none">Does the integration of sustainability certifications into pharmaceutical companies enhance sustainability performance perception of patients?How can blockchain technology facilitate the verification and validation of sustainability claims and certifications across multiple stakeholders in the pharmaceutical value chain?How can AI be integrated to enhance SDG performance of Pharma companies?
Organizational Readiness to innovation (Organization’s Theory)	Organizational Communication and Learning	IoT,Cloud,Big Data,Blockchain,AI, Robots, 3D, AR, VR, Digital Twins	DD, CT, MK, SC, MA	Satwekar et al. 2022; Alharthi, Cerotti, and Far 2020; M. Sharma et al. 2022; Kulkov 2021; Aquino et al. 2018	<ul style="list-style-type: none">What strategies can be employed to manage the transition from legacy systems to interoperable platforms and minimize disruption to ongoing operations, while maximizing the benefits of digital transformation across the value chain phases?How can organizations assess their current level of readiness and identify areas of improvement across the value chain phases?How does Organizational Readiness interact with Sustainability Practices, and what Digital technologies can be leveraged for enhanced performance?
Ensuring Drug Safety, Counterfeit Drug Prevention and Higher Accessibility to Drugs (Stakeholders Theory)	Impact on Patient	AI, IoT, Cloud, Blockchain, 3D, Big Data	MA, SC	Kulkov 2021; Chen et al. 2020; Zakari et al. 2022; Zulfiqar et al. 2022; M. Sharma et al. 2022; Lima Jr et al. 2021; Silva et al. 2020; Aquino et al. 2018; Ding 2018; Nguyen et al. 2022; Liu et al. 2021; Hosseini Bamakan et al. 2021; Kordestani, Oghazi, and Mostaghel 2023; Ghadge et al. 2022; Ertz, Centobelli, and Cerchione 2022; Junaid et al. 2023	<ul style="list-style-type: none">How can AI-powered chatbots and virtual assistants enhance patient education and provide accurate information about drug usage, potential side effects, and interactions, contributing to higher drug safety awareness and patient empowerment?How can big data analytics and predictive modeling be applied to identify patterns and trends in adverse drug events, enabling proactive measures in market access and supply chain to prevent potential harm to patients?How the use of AI can support in fighting counterfeited drug markets?

Demographics: 511 Respondents

Firm Size		
Employees	Frequency	Percentage
0-249 Employees	326	63.80 %
+250 Employees	185	36.20 %
Total	511	100 %

Pharmaceutical Value Chain Area		
Value Chain Areas	Frequency	Percentage
Drug Development and Research	110	21.53 %
Manufacturing	177	34.64 %
Customer and Patient Access	224	43.84 %
Total	511	100 %

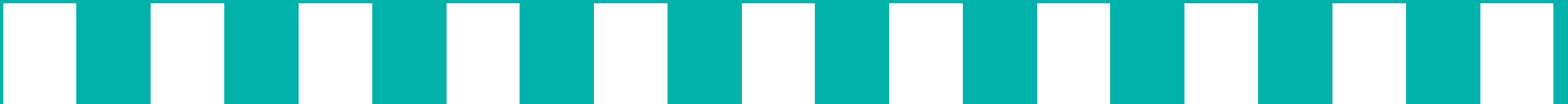
Geographic Area		
Continents	Frequency	Percentage
Africa	171	33.46 %
Asia	14	2.74 %
Europe	290	56.75 %
America	36	7.05 %
Total	511	100 %



Constructs	Items	Questionnaire
Effort Expectancy (E_Exp)	E_Exp 1	I find AI Easy to learn
	E_Exp 2	I find AI Easy to use
Behavioural Intention (B_Int)	B_Int 1	I intend to adopt AI in the next year
	B_Int 2	I predict I would use AI in the next year
	B_Int 3	I plan to adopt AI in the next year
Performance Expectancy (P_exp)	P_exp 1	I find AI useful in my job.
	P_exp 2	I find AI useful to accomplish tasks more quickly
	Si_1	Acceptance and adoption of AI is supported by management

Findings

- **Direct Effects**
- **Mediation Effects**



Direct Effects

Hypothesis	Loadings	Standard Deviation	T Statistics	P value	Interpretation
H1.a.I: S_read \rightarrow B_Int	$\gamma=0.392$	0.060	6.549	***	Accepted
H1.a.II: S_read \rightarrow Si	$\gamma=0.419$	0.062	6.810	***	Accepted
H1.a.III: S_read \rightarrow E_Exp	$\gamma=0.148$	0.066	2.234	**	Accepted
H1.a.IV: S_read \rightarrow P_Exp	$\gamma=0.348$	0.056	6.255	***	Accepted
H1.b.I: Cog_read \rightarrow B_Int	$\gamma=0.086$	0.055	1.558		Rejected
H1.b.II: Cog_read \rightarrow Si	$\gamma=0.219$	0.057	3.812	***	Accepted
H1.b.III: Cog_read \rightarrow E_Exp	$\gamma=0.386$	0.066	5.827	***	Accepted
H1.b.IV: Cog_read \rightarrow P_Exp	$\gamma=0.109$	0.052	2.104	**	Accepted
H2.a: B_Int \rightarrow SDG	$\beta=0.131$	0.092	1.433		Rejected
H2.b: Si \rightarrow SDG	$\beta=0.174$	0.080	2.177	**	Accepted
H2.c: E_Exp \rightarrow SDG	$\beta=0.119$	0.066	1.807		Rejected
H2.d: P_Exp \rightarrow SDG	$\beta=-0.179$	0.120	-1.493		Rejected
H3.a.I: S_Read \rightarrow SDG	$\gamma =0.558$	0.075	7.986	***	Accepted
H3.b.I: Cog_Read \rightarrow SDG	$\gamma =0.303$	0.069	4.442	***	Accepted
H4: SDG \rightarrow ECP	$\beta=0.194$	0.046	4.183	***	Accepted
H5.a: B_Int \rightarrow ECP	$\beta=0.151$	0.084	1.799		Rejected
H5.b: Si \rightarrow ECP	$\beta=0.196$	0.068	2.870	***	Accepted
H5.c: E_Exp \rightarrow ECP	$\beta=0.088$	0.057	1.557		Rejected
H5.d: P_Exp \rightarrow ECP	$\beta=0.260$	0.109	2.384	**	Accepted

Mediation Effects

Hypothesis	Loadings	Standard Deviation	P value	Lower Limit	Upper Limit	Interpretation
H3.a.II: S_read → B_Int→SDG	$\beta=0.051$	0.037	***	-0.06906	0.18951	Accepted
H3.a.III: S_read → Si →SDG	$\beta=0.073$	0.035	***	-0.03651	0.20821	Accepted
H3.a.IV: S_read →E_Exp→SDG	$\beta=0.018$	0.013	***	-0.01626	0.07706	Accepted
H3.a.IV: S_read → P_Exp → SDG	$\beta=-0.062$	0.043	***	-0.22486	0.07702	Accepted
H3.b.II: Cog_read → B_Int → SDG	$\beta=0.011$	0.011	***	-0.01981	0.06716	Accepted
H3.b.III: Cog_read →Si →SDG	$\beta=0.038$	0.020	***	-0.01879	0.12513	Accepted
H3.b.IV: Cog_read → E_Exp → SDG	$\beta=0.046$	0.027	***	-0.03791	0.15008	Accepted
H3.b.IV: Cog_read → P_Exp → SDG	$\beta=-0.020$	0.016	***	-0.09576	0.02837	Accepted
H6.a: B_Int → SDG →ECP	$\beta=0.034$	0.017	***	-0.01676	0.10743	Accepted
H6.b: Si → SDG →ECP	$\beta=0.025$	0.019	***	-0.03519	0.10287	Accepted
H6.c: E_Exp → SDG →ECP	$\beta=0.023$	0.014	***	-0.01938	0.08112	Accepted
H6.d: P_Exp → SDG →ECP	$\beta=-0.035$	0.025	***	-0.13645	0.04401	Accepted