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AGILE METHODS IN BUSINESS

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Abstract: This article presents literature across four linked domains — Agile practices, AI adoption, Digital Transformation, and Environmental Sustainability Performance — alongside the moderating role of Digital Leadership. The nexus of digital innovation and environmental responsibility is one of the most strategic issues facing organizations in the 21st century. Pressured by mounting pressures related to climate change, resource exhaustion, and increasing regulations, global organizations are shifting from merely 'symbolic sustainability commitments' to tangible and operational green performance [1,2]. However, there has always been and will continue to be a notorious and consistent "intent-practice" gap: the gap between green strategies that are designed at the organizational level, and the actual environmental outcomes at the operational level. Three forces that appear especially salient include Agile practice, Artificial Intelligence (AI) capabilities, and Digital Transformation (DT). Agile practices, stemming from iterative development, incremental delivery, learning from retrospective events and self-organizing teams, are becoming increasingly ubiquitous outside of software development [3,4]. AI capabilities offer predictive analysis, intelligent automation, and data-supported decision making [5,6], whereas Digital Transformation is the organizational environment where AI capabilities will become more prevalent and sustainble [7]. In this regard, we develop and test an integrative model by PLS-SEM as shown in [8].

Keywords: agile methods in business, artificial intelligence adoption, digital transformation and sustainability, environmental sustainability performance, digital leadership as a moderator.

Аннотация: Данная статья представляет обзор литературы по четырем взаимосвязанным направлениям — гибкие методы управления (Agile), внедрение искусственного интеллекта (ИИ), цифровая трансформация и экологическая устойчивость деятельности организаций, а также рассматривает модерирующую роль цифрового лидерства. Взаимосвязь цифровых инноваций и экологической ответственности является одной из наиболее стратегически важных проблем, стоящих перед организациями XXI века. Под усиливающимся давлением, связанным с изменением климата, истощением природных ресурсов и ужесточением экологического регулирования, организации по всему миру переходят от формальных или «символических обязательств в области устойчивого развития» к реальным и практическим экологическим результатам [4,6].

Однако сохраняется хорошо известный разрыв между намерениями и практикой — различие между экологическими стратегиями, разработанными на организационном уровне, и фактическими экологическими результатами на уровне операционной деятельности. Среди факторов, способных сократить этот разрыв, особое значение имеют гибкие методы управления (Agile), возможности искусственного интеллекта (ИИ) и цифровая трансформация (DT).

Гибкие методы управления, основанные на итеративной разработке, поэтапной поставке результатов, обучении на основе ретроспектив и самоорганизующихся командах, все шире

применяются за пределами сферы разработки программного обеспечения [8,11]. Возможности искусственного интеллекта обеспечивают прогнозную аналитику, интеллектуальную автоматизацию и принятие решений на основе данных [9,12], тогда как цифровая трансформация представляет собой организационную среду, в которой внедрение и эффективное использование ИИ становятся более масштабными и устойчивыми [13].
В связи с этим в настоящем исследовании разработана и эмпирически проверена интегративная концептуальная модель с использованием метода моделирования структурными уравнениями на основе частичных наименьших квадратов (PLS-SEM), как рекомендовано.
Ключевые слова: гибкие методы управления в бизнесе, внедрение искусственного интеллекта, цифровая трансформация и устойчивое развитие, экологическая устойчивость деятельности организаций, цифровое лидерство как модерирующая переменная.

Annotatsiya: Ushbu maqolada o‘zaro bog‘liq bo‘lgan to‘rtta yo‘nalish — biznesdagi Agile usullari, sun’iy intellektni (SI) joriy etish, raqamli transformatsiya hamda ekologik barqarorlik samaradorligi bo‘yicha adabiyotlar tahlil qilinadi. Shuningdek, raqamli yetakchilikning moderator sifatidagi roli ham ko‘rib chiqiladi. Raqamli innovatsiyalar va ekologik mas’uliyat o‘rtasidagi bog‘liqlik XXI asrda tashkilotlar oldida turgan eng muhim strategik masalalardan biridir. Iqlim o‘zgarishi, tabiiy resurslarning kamayishi va ekologik me’yorlarning kuchayishi natijasida dunyo bo‘ylab tashkilotlar faqat «ramziy barqarorlik majburiyatlari» bilan cheklanib qolmay, balki amaliy va aniq ekologik natijalarga erishishga intilmoqda [4,6].
Shunga qaramay, tashkilotlarning ekologik strategiyalari bilan ularning amaliy ekologik natijalari o‘rtasida «niyat va amaliyot» tafovuti hanuzgacha saqlanib qolmoqda. Ushbu tafovutni kamaytirishda ayniqsa uchta omil muhim ahamiyat kasb etadi: Agile amaliyotlari, sun’iy intellekt (SI) imkoniyatlari va raqamli transformatsiya (RT).
Agile usullari iterativ ishlab chiqish, bosqichma-bosqich natijalarni yetkazib berish, retrospektiv tahlil orqali o‘rganish hamda o‘zini o‘zi boshqaruvchi jamoalarga asoslanadi va bugungi kunda dasturiy ta’minot ishlab chiqish sohasidan tashqarida ham keng qo‘llanilmoqda [8,11]. Sun’iy intellekt imkoniyatlari prognozli tahlil, aqlli avtomatlashtirish va ma’lumotlarga asoslangan qaror qabul qilishni ta’minlaydi [9,12]. Raqamli transformatsiya esa SI texnologiyalarini tashkilot faoliyatiga kengroq joriy etish va ularning uzoq muddatli samaradorligini ta’minlovchi tashkiliy muhitni yaratadi [13].
Shu munosabat bilan ushbu tadqiqotda PLS-SEM (Partial Least Squares Structural Equation Modeling) usuli yordamida integratsiyalashgan konseptual model ishlab chiqildi va empirik jihatdan sinovdan o‘tkazildi.
Kalit so‘zlar: biznesda Agile usullari, sun’iy intellektni joriy etish, raqamli transformatsiya va barqaror rivojlanish, ekologik barqarorlik samaradorligi, moderator sifatidagi raqamli yetakchilik.

1.INTRODUCTION

1.1 AGILE METHODS IN BUSINESS

An approach that originates from the field of software engineering, Agile centers around the use of four core pillars: iterative development, incremental delivery, retrospective learning, and self-organizing teams (Tripp et al., 2016; Rietze & Zacher, 2022). Agile practices may promote resource efficiency and decrease the amount of waste in operations (Gorski et al., 2024; Marnada et al., 2023) although there appears to be a scarcity of rigorous empirical evidence directly linking Agile maturity to environmental performance.

1.2 ARTIFICIAL INTELLIGENCE ADOPTION

AI technologies could support predictive analytics, processes optimization and automation for better operational results as well as reduced environmental impact [12]. A multi-item AI adoption scale was developed and validated by [12] in organizational management settings; it provided a psychometrically robust measure base for the current study. AI adoption would likely lead to better sustainability performance as it enables improved energy consumption, waste reduction and supply chain efficiencies [4]. Agile practices would provide a mechanism that enables AI adoption as it allows for experimentation, learning and adaptation [8].

1.3 DIGITAL TRANSFORMATION AND SUSTAINABILITY

Digital transformation (DT) is the adoption of digital technology within the organization, which is about reshaping its processes, structures, and culture [13]. The benefits of DT include "monitoring of environmental performance in real time, better allocation of resources, and increases in efficiency" [1,6]. Studies which analyze combined and sequential effects of Agile, AI and DT on the environment have been rather rare.

1.4 ENVIRONMENTAL SUSTAINABILITY PERFORMANCE

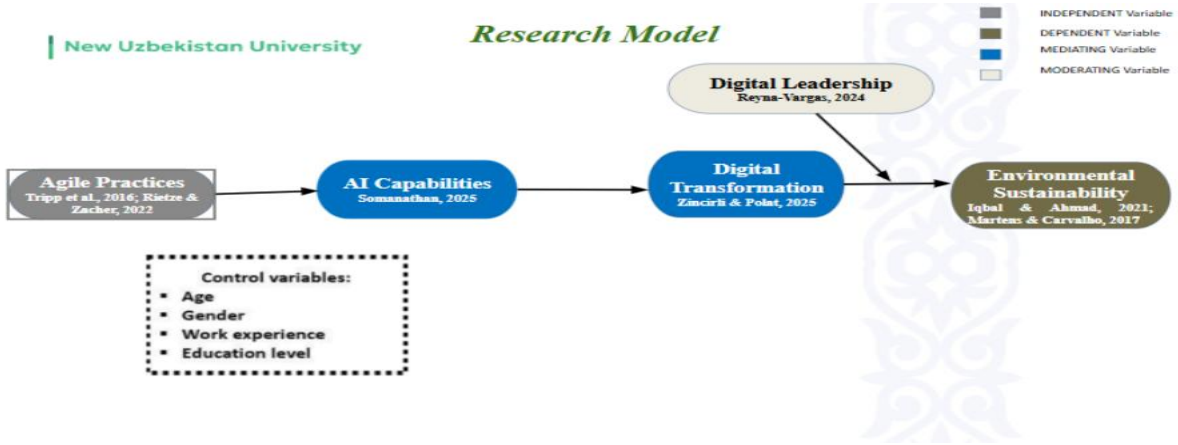
Environmental sustainability performance can be defined as the ability of an organisation to reduce its environmental consequences. Measurements for it include decreasing energy consumption and water consumption, reducing emissions and wastes, and hygienic process operation [4,6]. AI-enabled energy management systems have also proven to be efficient in reducing the consumption of energy within organisations[1].

1.5 DIGITAL LEADERSHIP AS A MODERATOR

Digital leadership has been defined as the ability of leaders to set an inspiring digital vision, advocate digital technologies, foster an empowering environment, and align digital strategy with the overall business strategy [7]. In its role as moderator it is underpinned by Upper Echelons Theory [3], which suggests that an organization's results are influenced by the values and capabilities of its top managers.

2.RESEARCH MODEL

The conceptual model indicates that AI Practice is the independent variable that impacts environmental sustainability performance via a sequential mediation of AI Capabilities (first mediator) and Digital Transformation (second mediator). DT is moderated by DL for DT-ES. Age, gender, work experience and education are added to structural model as covariances.



2.1. HYPOTHESIS DEVELOPMENT

Table 1. Summary of Proposed Research Hypotheses and Corresponding Research Questions

H	Statement	Type	RQ
H1	Agile practices have a positive effect on AI capabilities in sustainability-oriented projects.	Direct	RQ1
H2	AI capabilities positively influence Digital Transformation initiatives.	Direct	RQ2
H3	Digital Transformation positively impacts Environmental Sustainability performance.	Direct	RQ3
H4	**Agile practices → DT through the mediating role of AI capabilities.**	Mediation	RQ4
H5	**AI capabilities → ES through the mediating role of Digital Transformation.**	Mediation	RQ5
H6	**Digital Leadership moderates the DT → ES relationship.**	Moderation	RQ6

H7	**AI Capabilities and DT serially mediate Agile Practices → ES.**	Serial Med.	RQ7

2.1.1. H1 – Agile Practices on AI Capabilities

H1: Agile practices have a positive effect on AI capabilities in sustainability-oriented projects.

Agile practices enable an organisational culture where it is structurally amenable to AI introduction. Iterative sprint processes enable teams to experiment with AI tools in low risk iterations, whilst retrospect meetings institutionalize the continuous learning process. The speed, breadth and the embedding of AI will benefit considerably by a certain degree of maturity in the Agile process.

2.1.2. H2 – AI Capabilities on Digital Transformation

H2: AI capabilities positively influence Digital Transformation initiatives.

AI adoption — encompassing AI integration, predictive analytics, automation, and decision support — is a primary catalyst for broader organisational digital transformation [12]. When AI tools become embedded in operational processes, they generate demands for re-engineered workflows, updated data architectures, and new digital competencies.

2.2.3. H3 – Digital Transformation on Environmental Sustainability

H3: Digital Transformation positively impacts Environmental Sustainability performance.

DT allows organizations to measure, observe, and optimize the environmental performance in a degree of detail which was not previously possible under the pre-digital framework [13]. It contributes to the improvement in energy efficiency, waste management and operational cleanliness.

2.2.4. H4 – Mediating Role of AI Capabilities

H4: Agile practices are positively associated with Digital Transformation through the mediating role of AI capabilities.

Agile practices cultivate the experimental mindset and infrastructure that allow AI tools to be adopted and refined. Once AI capabilities are established, they trigger the structural and cultural changes that constitute Digital Transformation .

2.2.5. H5 – Mediating Role of Digital Transformation

H5: AI capabilities are positively associated with Environmental Sustainability performance through the mediating role of Digital Transformation.

AI functions have implicit potential for enhancing environmental performance, yet this potential is only materialized in the case that AI is institutionalized within an digitally transformed organization. DT is the intermediary between this relationship, enabling the integration of AI outputs into organizational workflows.

2.2.6. H6 – Moderating Role of Digital Leadership

H6: Digital Leadership moderates the relationship between Digital Transformation and Environmental Sustainability performance.

Digital leaders determine whether DT initiatives remain anchored to sustainability goals. This moderation is grounded in Upper Echelons Theory and contingency theory.

2.2.7. H7 – Full Serial Mediation Pathway

H7: AI Capabilities and Digital Transformation sequentially mediate the relationship between Agile Practices and Environmental Sustainability Performance.

The chain of serial mediation of the fully combined Agile AI DT ES includes all four constructs within a single chain of causal relationships which reflects dynamic capabilities theory such that sensing (Agile) stages are triggered before seizing (AI) stage which in turn triggers the reconfiguring (DT) stage, until performance outputs is obtained.

CONCLUSION

Three voids call for these hypotheses: firstly, no research has tested H1, H2, and H3 at the same time under the same PLS-SEM and model configuration in a sustainability context. Secondly, H4, H5, and H7 fill in the void for serial mediation within the Agile-AI-DT-ES pipeline. Thirdly, H6 fills in a major void, that there is almost no empirical research done on Digital Leadership as a moderator in sustainability DT research [7].

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