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SUSTAINABILITY AND AI

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INTRODUCTION

SUSTAINABILITY IS A KEY OBJECTIVE FOR ORGANISATIONS AND AI PROVIDES TOOLS THAT CAN ACCELERATE THE JOURNEY. BUT AI AND SUSTAINABILITY, SEPARATELY AND TOGETHER, REQUIRE A RIGOROUS AND COMPREHENSIVE TRANSFORMATION DESIGNED FOR THE SPECIFIC CHALLENGES THAT THEY INTRODUCE.

This article examines these challenges and how a transformation should be designed to resolve them. It considers:

- The relationship between AI and sustainability;
- The challenges of AI transformation;
- The challenges of implementing AI as part of the sustainability journey;
- How to design a transformation to address the challenges.

This article was developed by Paul Walton, Jasmin Booth, Chris Dawkins, Jamie Rich, and Ewart Adams (Capgemini), Tom Weston, Max Riffi-Aslett, Haocheng Lin, Yuqing Yang and Raya Kamleh (UCL students) as part of a project to consider these questions.

AI AND SUSTAINABILITY

There is widespread agreement that AI can enable and accelerate the implementation of sustainability. For example:

- "Artificial Intelligence (AI) can help us fight climate change" (EU Horizon)
- "We identify two crucial opportunities that AI offers in this domain: it can help improve and expand current understanding of climate change, and it can contribute to combatting the climate crisis effectively" (National Library of Medicine)
- "By 2030, AI-enabled use cases have the potential to help organizations fulfil 11–45% of the 'Economic Emission Intensity' targets of the Paris Agreement." (Capgemini)
- "The application of AI levers could reduce worldwide greenhouse gas emissions by 4% in 2030… – equivalent to the 2030 annual emissions of Australia, Canada and Japan combined" (PWC).

But the news is not uniformly positive. The development and use of the machine learning models that are driving the growth of AI is energy intensive and may inhibit the achievement of sustainability goals. Their energy use is growing at an alarming rate as they become more complex and capable. For example:

- "Modern computing systems consume far too much energy. They are not sustainable platforms for the complex artificial intelligence (AI) applications that are increasingly a part of our lives." (Nature).
- "However, the development of AI also raises two sets of problems when considering climate change: the possible exacerbation of social and ethical challenges already associated with AI, and the contribution to climate change of the greenhouse gases emitted by training data and computation-intensive AI systems." (National Library of Medicine).

This presents a challenge: how can these tensions be reconciled?

THE CHALLENGES OF AI TRANSFORMATION

AI is not just another type of technology. Using AI for sustainability will only succeed if the implementation of AI as a whole succeeds in an organisation. But implementing AI and enabling it to scale requires much more than just the implementation of the technology:

- "Too many business leaders still believe that AI is just another 'plug and play' incremental technological investment. In reality, gaining a competitive advantage through AI requires organizational transformation ... These companies don't just have better technology — they have transformed the way they do business so that human resources can be augmented with machine powers." Hbr.org: The secret to AI is people.

This requires a carefully considered transformation approach:

- "To capture the full promise of AI…companies must reimagine…the way work gets done" Hbr.org: Getting AI to scale
- Scaling AI requires the right ethical framework—one of the key ethical principles (using the EU principles as an example) is "societal and environmental well-being" which includes sustainability
- Scaling AI requires the ability to control the new risks that AI introduces.

This provides a pleasing symmetry but also an additional challenge: ethical AI needs sustainability and effective sustainability needs AI. Indeed, definitions of sustainability are very closely related to one of the ethical principles for AI. For example:

- Sustainability: "sustainability refers to doing business without negatively impacting the environment, community, or society as a whole."
- AI societal and environmental principle: "AI systems should benefit all human beings, including future generations. It must hence be ensured that they are sustainable and environmentally friendly. Moreover, they should take into account the environment, including other living beings, and their social and societal impact should be carefully considered."

AI technology is changing fast so the end state isn't clear. This means that the transformation needs to be iterative and incremental, building the organisational enablers of AI in time to support scaled use cases (as shown in Figure 1).

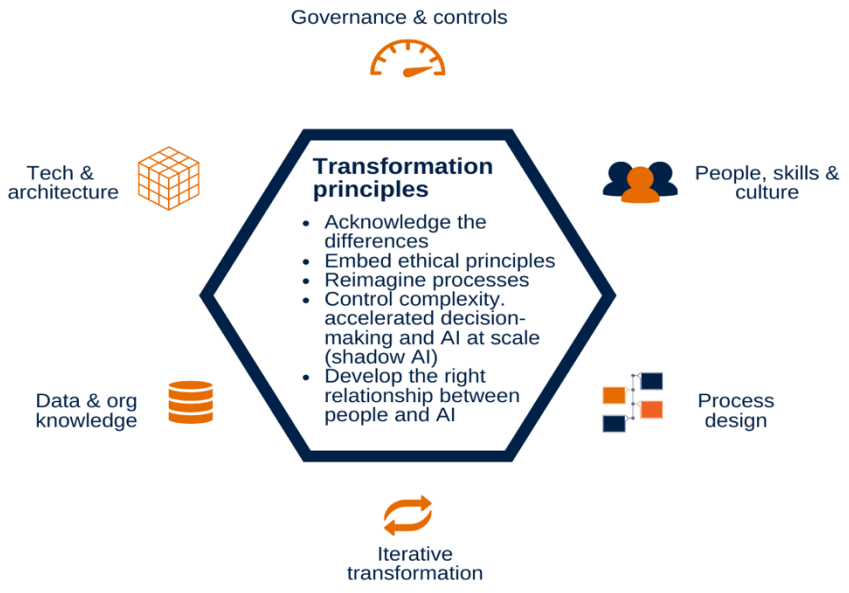

Figure 1: Implementing AI at scale needs a rigorous transformational approach

THE CHALLENGES OF IMPLEMENTING AI AS PART OF THE SUSTAINABILITY JOURNEY

Sustainability requires that organisations should "optimise for both social and business value" and this requires changes to corporate strategy supported by a corresponding transformation.

Delivering these changes will require fundamental differences in ways of working and governance. Decisions about sustainability need to be incorporated everywhere they may have an effect: in policies, in business cases, in processes through all levels of an organisation and its supply chain and ecosystem.

The scale is large. Any transformation extends outside the scope of the organisation because the sustainability of products and services depends on the supply chain. The supply chain accounts for a substantial proportion of energy use but there are many challenges:

- "First-tier suppliers, for their part, rarely concern themselves with their own suppliers' sustainability practices. That's often because they're struggling with sustainability issues themselves".

However, there is considerable potential. In some cases, the use of AI and new technologies has already impacted the supply chain: including "demand-forecasting models, end-to-end transparency, integrated business planning, dynamic planning optimization, and automation of the physical flow—all of which build on prediction models and correlation analysis to better understand causes and effects in supply chains". This impact is likely to accelerate.

Sustainability requires transforming the supply chain, but the scale of change required is also daunting in another respect. Information about sustainability needs to be embedded in decision-making throughout the organisation because practically all business activities involve energy use. This means that sustainability needs the same level of organisational governance infrastructure as finance. A reflection on the complexity of finance governance and its impact on processes and technology gives an indication of the level of change needed. The implications of this breadth and depth are considerable and can be seen in Table 1.

Table 1: Implications for Transformation of Sustainability with AI

Dimension	Implications
Strategy	• Sustainability requires "reimaging corporate strategy by creating new modes of differentiation, embedding societal value in products and services, reimaging business models for sustainability, managing new measure of performance, and reshaping business ecosystems"
Supply Chain	• The use of AI and new technologies has already impacted the supply chain, including "demand-forecasting models, end-to-end transparency, integrated business planning, dynamic planning optimization, and automation of the physical flow – all of which build on prediction models and correlation analysis to better understand causes and effects in supply chains".
Governance	• The implementation of AI requires appropriate ethical AI governance • Both AI and sustainability require changes to key controls and governance mechanisms • Both AI and sustainability to require mature governance of organisational trade-offs (like agility vs sustainability or efficiency vs sustainability). Just as organisations accumulate technical

	debt because of tradeoffs about technology choices, so there is a likelihood that organisations will also accumulate and need to manage "sustainability debt".

Processes	• Both AI and sustainability require processes to be reimagined:
	  • AI: "To capture the full promise of AI…companies must reimagine…the way work gets done"
	  • Sustainability: "Many companies will respond to the ever-louder calls by investors and stakeholders for more disclosure and higher-quality, reliable ESG data and reporting. But that alone is insufficient to bring the worlds of strategy and sustainability together and secure resilience and durable competitive advantage while also increasing environmental and societal benefits. The continuous practice of sustainable business model innovation is the engine to do so." These changes have major impacts on processes.

Measurement	• Implementing AI to support sustainability requires a comprehensive approach to the measurement of the ethics of AI. • But measuring the impact of AI is challenging: "Measurement of the environmental impacts of AI compute and applications is limited by a lack of common terminology, recognised standards, consistent indicators and metrics, and varying or optional reporting requirements"
Culture and Skills	• Sustainability: "This approach is only achievable if an organisation has the right people and sustainability mindset. …For this to be achieved at scale requires an approach based on empathy, openness, collaboration, and trust." • AI: The implementation of AI at scale needs a wide range of skills. These include the new technology and data science skills, but also the new skills required across the organisation work in new ways with AI technologies. • Environmental intelligence: "Environmental Intelligence is a new field of knowledge that exploits the explosion in Environmental data and the rapid advances in Artificial Intelligence to create solutions to some of the most important challenges facing society today."
Data	• Waste: The Economist reports that 'between 70% and 90% of data that organisations collect is "dark data" that incurs unnecessary energy costs to transmit and store without being turned into insights and business opportunities' • Sustainability: Measuring and managing sustainability requires access to new data across the supply chain and within an organisation • AI: Implementation of AI at scale requires an enterprise-wide implementation of both data and ethical governance.

Technology	• Gartner have categorised the components of sustainable technology. These are:
	  • Sustainability by design for new systems (in other words, treating sustainability in the same way as security and other attributes of technology
	  • Energy-efficient software
	  • Sustainable data centres of cloud services
	  • End-to-end design thinking for sustainability
	  • Energy-efficient hardware and circular economy practices
	  • Energy-efficient architecture and networking
	  • Low-carbon energy sources

DESIGNING A TRANSFORMATION TO RESOLVE THE CHALLENGES

The journey to a sustainable future using AI needs a complex and rigorous transformation approach that addresses the specific challenges that sustainability with AI brings.

Table 1 demonstrates that sustainability and AI each needs a wide range of changes at the scale of the enterprise as a whole and its supply chain. These changes include the following:

- **Processes and governance:** These need to be reimagined to take full advantage of AI and embed decisions about sustainability at the level of detail needed. But the governance will also need to recognise that difficult tradeoffs may be required, for example between sustainability, agility and efficiency and between the use of AI and its energy consumption.
- **Organisational change**: A change of this magnitude needs a comprehensive approach to organisational change to put in place the enablers for success. Both AI and sustainability are difficult concepts for people to embrace and incorporate successfully in their work. In addition, together they present a major change to the nature of jobs and work.
- **Architecture**: These processes will need an architecture to enable them and their continual improvement. The key here is process improvement. The worlds of AI and sustainability are constantly developing and the need to adapt continuously is paramount. This means that a composable architecture will be needed, supported by low code technologies that enable both rapid change and the ability to integrate with diverse new services.
- **Digital services**: The digital product lifecycle will need AI and sustainability governance and assurance in to avoid unexpected consequence. The governance will be needed in the procurement and management of third-party services as well as in-house product management.
- **Data**: Both AI and sustainability need high quality data. This can only be achieved at scale if data governance and a rigorous data engineering approach are implemented.

We can draw some important conclusions from this list. The nature of the change required is truly transformational—this is not just the implementation of new technology. Also, the governance of AI changes and sustainability changes must be integrated into a coherent approach that can support both—ethical AI needs sustainability and effective sustainability needs AI.

CONCLUSION

AI provides tools that can accelerate an organisation's journey to sustainability. But both AI and sustainability, separately and together, introduce challenges that require a rigorous and comprehensive transformation approach.

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CAPGEMINI

Capgemini is a global leader in consulting, digital transformation, technology and engineering services. The Group is at the forefront of innovation to address the entire breadth of clients' opportunities in the evolving world of cloud, digital and platforms.

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The **UCL School of Management** is the business school of University College London, one of the world's leading universities, consistently ranked in the global top 20 for its academic excellence and research. The School offers innovative undergraduate, postgraduate, PhD and executive programmes in Management, Entrepreneurship, Business Analytics, Business Information Systems, and Finance, designed to prepare students for leadership roles in the

THE ANALYTICS LAB

The Analytics Lab is an enrichment module for UCL students where they are able to explore topical questions in the domain of analytics and digital economy via hands-on experience. Students are offered the opportunity to conduct research and work on projects with leading technology service and consulting companies, discuss and develop their own ideas and projects.

It aspires to help UCL students and alumni to be in the heart of fundamental changes and digital transformations in the business environment primarily but not limited to. Students enhance their practical abilities to manage analytics and digital operations effectively in view of rapidly developing technological advancements in the relevant domains.