

# "WHO LEADS THE FUTURE? RETHINKING LEADERSHIP FOR THE NEW ECONOMY"

## *Concept Paper*

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### **“Abstract”**

*The global economy is experiencing a structural shift at the intersection of sustainability imperatives, digital transformation, and systemic disruption. Yet this “new economy” faces mounting volatility and uncertainty, exposing the fragility of leadership approaches anchored in hierarchy, reactivity, and male-dominated structures.*

*This conceptual paper identifies the underrepresentation of women in strategic decision-making as a governance gap that undermines resilience, legitimacy, and adaptability. Drawing on evidence linking inclusive leadership to stronger risk management, innovation, and stakeholder trust, it introduces three purpose-build frameworks: the SHIFT Model, mapping the macro forces of transformation; the Future-Ready Leadership Framework, specifying the capabilities leaders require; and the NEXT Model, embedding diversity, ethics, and systemic thinking into governance.*

*Together, these interconnected frameworks extend leadership and governance theory for the digital-green economy, offering a roadmap for developing systems that are not only technologically advanced and sustainable, but also socially just and resilient.*

*Keywords: New Economy, Inclusive Leadership, Strategic Governance, Digital-Green Economy*

## **1 Introduction**

The global economy is entering a “new” phase shaped by the convergence of sustainability transition, rapid technological change, and shifting expectations. This transformation is not defined by a single sector or technology but by the integration of the green transition, digital acceleration, and systemic changes in value creation. While Industry 4.0’s automation and connectivity and Industry 5.0’s human-centric sustainability laid important groundwork, they are insufficient to address today’s volatile and complex environment.

Traditional leadership research has focused on efficiency, expertise, and hierarchical control. Yet the speed and interconnectedness of current disruptions expose the limits of these assumptions. At the same time, leadership credibility is in decline, with trust in senior leaders at historically low levels. Governance structures remain predominantly male-dominated and technocratic, risking the replication of past inequities in AI systems, green policies, and innovation ecosystems. This underrepresentation of women is not only an equity concern but a strategic governance gap. Without inclusive leadership, transitions risk losing legitimacy, overlooking vulnerable stakeholders, and failing to deliver resilient systems.

This paper addresses this central question: *Who leads the future, and how?* Furthermore, it introduces three new, author-developed, and interconnected frameworks:

- i. SHIFT Model: maps the macro forces reshaping the economy;
- ii. Future-Ready Leadership Framework: specifies the capabilities leaders require;

iii. NEXT Model: embeds these capabilities into governance through diversity, ethics, and systemic thinking.

Thus, this paper contributes by:

- Framing women's underrepresentation as a governance gap, with direct consequences for resilience and legitimacy;
- Integrating fragmented literatures into the SHIFT→Future-Ready→NEXT framework linking macro forces, leadership capabilities, and governance;
- Positioning female leadership as a strategic enabler, embedding inclusivity into the foundations of resilience and sustainable transformation.

Together, these interconnected frameworks extend leadership and governance theory for the digital-green economy and offer a roadmap for leadership systems that are equitable, resilient, and future-fit.

## 2 The New Economy

The 21st-century economy is undergoing a profound transformation, shaped by the convergence of sustainability imperatives, rapid technological change, and shifting societal expectations (Schwab, 2017; Breque *et al.*, 2021). This transformation is neither sector-bound nor linear, it represents a systemic reconfiguration of how value is created, distributed, and sustained (Santos *et al.*, 2025). However, what makes the present moment particularly striking is the pace and intensity of these changes: sustainability imperatives, digital disruption, and social transformation are unfolding simultaneously and over a relatively short timespan. The cumulative effect is a period of unprecedented volatility and interdependence, where earlier frameworks offer only partial guidance (Whitehead *et al.*, 2025). Today's complexity therefore demands a broader, integrative lens, one that can capture not only technological innovation, but also its societal, environmental, and governance implications.

### 2.1 From sustainability and AI origins to industry 5.0

The origins of today's shifts can be traced back to key conceptual milestones. The concept of sustainability entered the global stage in 1987 through the United Nations Brundtland Report, defining sustainable development as meeting "the needs of the present without compromising the ability of future generations to meet their own needs" (Butlin, 1989). The United Nations Sustainable Development Goals (SDGs), adopted in 2015, further operationalised this vision into 17 interconnected objectives that provide a universal blueprint for achieving peace, prosperity, and planetary wellbeing by 2030 (United Nations, 2015). These goals are commonly grouped into three interconnected pillars: the economic pillar, which includes objectives such as industry, innovation and infrastructure (SDG 9); the social pillar, which encompasses priorities like gender equality (SDG 5); and the environmental pillar, which focuses on urgent challenges such as climate action (SDG 13) (United Nations, 2015). Their integrative scope reflects the systemic interdependencies that characterise the new economy, where progress in one area is contingent on progress across others. Their integrative scope reflects the systemic interdependencies that characterise the new economy, where progress in one area is contingent on progress across others (Raworth, 2017; Birsan *et al.*, 2022).

In parallel, the concept of artificial intelligence (AI), first coined in the 1950s, matured into practical, large-scale applications in the last decade, increasingly shaping decision-making, automation, and societal interaction (Russell and Norvig, 2021). Today, AI technologies influence everything from predictive analytics in finance and logistics to medical diagnostics, personalised marketing, and autonomous systems. At the same time, their rapid deployment has triggered profound disruption, raising questions about algorithmic bias, workforce displacement, data governance, and ethical

accountability (Floridi *et al.*, 2021). Far from being a neutral tool, AI actively reconfigures power relations between organisations, governments, and individuals, reshaping labour markets, regulatory debates, and even democratic processes. This disruptive potential positions AI as both a catalyst for efficiency and innovation and a source of systemic risk, underscoring the need for leadership that can balance technological opportunities with ethical foresight and inclusive governance (UNESCO, OECD, and IDB, 2022).

The Fourth Industrial Revolution, or Industry 4.0, emerged as a term in the early 2010s to describe the integration of advanced digital technologies—such as the Internet of Things (IoT), big data, artificial intelligence (AI), robotics, and smart factories—into manufacturing and industrial processes (Lasi *et al.*, 2014; Schwab, 2017). This era leveraged cyber-physical systems to create interconnected, intelligent environments capable of autonomous decision-making and real-time optimisation. Furthermore, the integration of Industry 4.0 and circular economy principles increasingly requires leadership and cultural adaptation, a trend captured in the emerging concept of Digital Green Lean (Gatell and Avella, 2023).

By the early 2020s, Industry 5.0 evolved as a response to the limitations of purely technology-driven progress, emphasising collaboration between humans and intelligent systems, with a focus on human-centricity, sustainability, and resilience (Breque *et al.*, 2021; Xu *et al.*, 2021; Gamberini and Pluchino, 2024; Santos *et al.*, 2025). Thus, rather than replacing human roles, Industry 5.0 sought harmonious integration, aligning innovation with environmental goals and circular economy principles (Nahavandi, 2019; Rejeb *et al.*, 2025).

However, recent geopolitical and societal shocks, including the COVID-19 pandemic, global supply chain crises, and regional conflicts with global implications, have revealed that neither one of these concepts adequately cover and fully capture today's complexity. In this context, the current landscape is better described through the lenses of VUCA—volatility, uncertainty, complexity, ambiguity (Bennett and Lemoine, 2014) and BANI—brittle, anxious, nonlinear, incomprehensible (Cascio, 2020), highlighting the fragility and unpredictability of systems in this era. Together, these frameworks capture not only the speed and scale of disruption, but also its psychological and organisational consequences. In VUCA context, volatility creates instability in markets and supply chains, uncertainty undermines forecasting and strategic planning, complexity generates interdependencies that defy linear solutions, and ambiguity blurs the boundaries of decision-making (Bennett and Lemoine, 2014). In BANI terms, brittle institutions collapse under stress, anxiety reduces collective capacity to respond, nonlinearity produces disproportionate ripple effects, and incomprehensibility challenges even the most advanced analytical tools (Cascio, 2020).

Thus, the new global economy, shaped by overlapping disruptions, cannot be defined by a single sector or technology. It is driven by the convergence of the green transition, digital acceleration, and systemic shifts in value creation. AI-driven automation, circular business models, and new frameworks are reshaping how economies operate. It is within this context that the following section provides a structured lens for understanding the macro forces at play.

## 2.2 The SHIFT model: macro forces of the new economy

Building on the above, this paper introduces the SHIFT Model, an original framework developed by the author, which identifies five interlinked forces that together define the operating environment of the new economy:

- i. Sustainability and Green Transition involves large-scale decarbonisation, the adoption of circular economy models, and the acceleration of green adaptation strategies. This force is driven by international commitments such as the Paris Agreement, national net-zero targets, and growing market demand for low-carbon solutions, requiring industries to fundamentally rethink resource use and environmental impact (United Nations, 2015; Breque *et al.*, 2021; Rejeb *et al.*, 2025);
- ii. Human-Centric AI and Digital Transformation reflect the dual challenge of harnessing technological innovation while ensuring ethical governance. This includes responsible AI

deployment, robust data governance, and digital inclusion to prevent the deepening of societal divides (Russell and Norvig, 2021; Floridi *et al.*, 2021; UNESCO, OECD, and IDB, 2022). Thus, AI adoption is not only a technical issue but also a matter of leadership trust (Development Dimensions International, 2025);

- iii. Innovation Ecosystems emphasise cross-sectoral and cross-border collaboration as the foundation for scaling complex solutions. In a globally networked economy, partnerships between academia, industry, governments, and civil society accelerate the diffusion of sustainable solutions (Westermann, Ashby and Pretty, 2005; Brammer, Millington and Pavelin, 2007);
- iv. Future-Ready Policy and Systemic Change calls for adaptive governance and institutional reform to keep pace with technological and environmental transformations. This requires agile regulatory frameworks, transparent policymaking, and systems-based approaches that anticipate interconnected risks (Bennett and Lemoine, 2014; Cascio, 2020; Whitehead *et al.*, 2025);
- v. Trust, Equity and Inclusive Growth is about fostering social cohesion and equitable access to opportunities. Without deliberate strategies for representation, fair participation, and stakeholder legitimacy, the legitimacy of both digital and green transitions can be undermined, particularly in contexts where inequalities are historically entrenched (Raworth, 2017; Birsan *et al.*, 2022; European Women on Boards, 2025).

These five forces do not operate in isolation; they are interdependent and mutually reinforcing. Understanding their interactions is critical for designing leadership strategies that can navigate complexity while delivering sustainable, equitable outcomes. **Figure 1** presents the author's SHIFT Model as a visual framework, offering a macro-level map of the critical forces that any leadership approach for the new economy must address.



Figure 1. The SHIFT Model. (Source: Own elaboration)

If the SHIFT Model maps the terrain, the next question is how leaders can navigate it. The challenges it outlines are not purely technical, but governance and leadership challenges. The ability to anticipate

disruption, manage trade-offs, and design systems that are both inclusive and future-ready will determine whether transformation delivers on its promises. The following chapter examines the leadership capabilities required in this context, investigating a critical question: what kind of leadership will navigate it successfully?

### 3 Leadership in the New Economy

Effective leadership in the new economy demands an evolved skillset that goes far beyond operational competence. In a world defined by both VUCA (Bennett and Lemoine, 2014) and BANI (Cascio, 2020), leaders must anticipate disruption, balance competing priorities, and design systems that are both ethical and future ready (Whitehead *et al.*, 2025). This requires not only navigating complexity and rapid change, but also building trust, making informed trade-offs, and aligning immediate actions with a long-term vision for sustainable, inclusive growth (Hunt *et al.*, 2020; McKinsey & Company and LeanIn.Org, 2024).

The convergence of the five macro forces in the SHIFT Model (Sustainability & Green Transition, Human-Centric AI & Digital Transformation, Innovation Ecosystems, Future-Ready Policy & Systemic Change, and Trust, Equity & Inclusive Growth) has redefined what effective leadership looks like (Santos *et al.*, 2025). Thus, leaders in the new economy must respond with agility, ethics, and systemic foresight and be future-ready (Karwan, Hariri and Ridwan, 2021).

#### 3.1 Future-Ready leadership framework

Future-ready leadership has long been pivotal in previous economic paradigms. In Industry 4.0, it ensured the alignment of people, processes, and technologies, enabling effective adoption of advanced systems such as IoT, AI, and robotics (Lasi *et al.*, 2014; Schwab, 2017; Guzmán *et al.*, 2020). Leaders articulated clear, forward-looking visions, used data-driven insights to guide balanced decisions, and managed change to mitigate resistance while maximising opportunity.

Industry 5.0 expanded this role by placing human-centricity, sustainability, and resilience at the core of innovation (Breque *et al.*, 2021; Xu *et al.*, 2021; Gamberini and Pluchino, 2024). Leaders were tasked with promoting collaboration between humans and intelligent systems, embedding ethical considerations into operations, and advancing circular economy principles (Nahavandi, 2019; Rejeb *et al.*, 2025).

However, the new economy goes beyond these industrial paradigms, requiring leadership that is adaptive, inclusive, and able to anticipate systemic change (Santos *et al.*, 2025). Similar to Guzmán *et al.* (2020), Gatell and Avella (2023) identify a set of leadership competences necessary for navigating Industry 4.0 and CE, many of which align with future-ready leadership dimensions.

Building on this, the author develops the Future-Ready Leadership Framework, a purpose-build model that specifies five interlinked dimensions of leadership particularly critical for the new economy:

- i. Impact-Driven Actions: This involves aligning resources, operations, and technologies with the parameters of the new economy. Leaders must integrate sustainability into operational strategy, enable human-technology collaboration, and build organisational capacity through skill development and innovation frameworks (Adams and Funk, 2012; Wang, Jin and Yoo, 2024; Henley Business School, 2025; Rejeb *et al.*, 2025);
- ii. Decision-Making: Leaders must address complex trade-offs between technology integration, sustainability, and workforce development. Decision-making processes must be data-driven yet ethically grounded, considering impacts on equity, privacy, and long-term social outcomes (Floridi *et al.*, 2021; Alshaibani, Bakir and Al-Atwi, 2024; Henley Business School, 2025);
- iii. Relationship Building: Sustained success in the new economy depends on trust-based relationships, within organisations, across sectors, and between humans and machines. Leaders must foster transparency, inclusivity, and cross-sector partnerships that accelerate

innovation and broaden legitimacy (Westermann, Ashby and Pretty, 2005; Brammer, Millington and Pavelin, 2007; Alshaibani, Bakir and Al-Atwi, 2024);

- iv. Strategic Vision: Future-ready leaders must create forward-looking perspectives that integrate human-centricity, sustainability, and resilience. They envision how organisations can thrive by aligning technological innovation with societal and environmental goals. Visionary leadership in the new economy requires balancing automation with human creativity (Karwan, Hariri and Ridwan, 2021; Wang, Jin and Yoo, 2024; Henley Business School, 2025);
- v. Systems Thinking: Future-ready leaders must grasp the interdependencies between technological, environmental, economic, and social systems. Systems thinking helps anticipate unintended consequences and balance competing priorities, building on system dynamics (Meadows, 2008), socio-ecological boundaries (Raworth, 2017), and Industry 5.0–circular economy linkages (Rejeb *et al.*, 2025).

These five dimensions of future-ready leadership are not just skills, but interconnected capabilities that reinforce one another. Together, they equip leaders to anticipate disruption, balance competing priorities, and design systems that are ethical, resilient, and inclusive. **Figure 2** presents the author's Future-Ready Leadership Framework as a visual model, translating the demands of the new economy into the leadership capacities required to navigate it effectively.



Figure 2. The Future-Ready Leadership Framework. (Source: Own elaboration)

However, while these five dimensions define the capabilities leaders require, they need to be translated into a coherent, actionable framework that bridges external disruptions and internal leadership responses. The next section develops this translation, showing how the SHIFT forces align with the Future-Ready Leadership dimensions in practice.

### 3.2 Operationalizing future-ready leadership

The author's original SHIFT Model outlines the five macro forces shaping the new economy—forces that redefine how organisations create value and governance. Yet identifying these forces is not enough; leaders must develop the capacities to respond to them with foresight and effectiveness. For example, Guzmán *et al.* (2020) highlight that effective Industry 4.0 leaders required a balance of cognitive, interpersonal, business, and strategic skills, underscoring that leadership transformation depends not only on technological expertise but also on broader human and strategic capabilities. This is where the author's Future-Ready Leadership Framework, also developed in this paper, provides the critical complement, as it translates external pressures into internal capabilities, bridging the gap between context and action (Whitehead *et al.*, 2025).

The integration of the two author-developed frameworks highlights a key principle: leadership in the new economy cannot be reactive. Instead, it must align organisational vision, decision-making, operations, relationships, and systems thinking with the broader transformations occurring at global scale (Karwan, Hariri and Ridwan, 2021; Henley Business School, 2025). For example, the sustainability and green transition demands not only decarbonisation strategies, but leaders who can operationalise impact-driven actions—embedding social and environmental outcomes into the very core of business models (Adams and Funk, 2012; Pierli, Murmura and Palazzi, 2022). Likewise, the disruption created by AI requires not only technical adoption, but leaders capable of ethical and inclusive decision-making, balancing innovation with fairness, trust, and long-term stakeholder value (Glass and Cook, 2017; Floridi *et al.*, 2021).

Thus, by aligning each macro force with a future-ready leadership dimension, the paper's frameworks create a direct bridge between what is changing in the external environment and how leaders must respond internally. This alignment transforms the SHIFT Model from a descriptive framework into a prescriptive tool for action, ensuring that leadership is not merely reacting to disruption but actively shaping outcomes and becoming future-ready.

**Table 1** presents this alignment, showing how each macro force translates into a specific leadership capability essential for steering organizations through the complexity of the new economy.

| Shift Force                                 | Future-Ready Leadership Dimension | Description   |
|---|-----------------------------------|---|
| Sustainability and Green Transition         | Impact-Driven Actions             | Embedding environmental and social impact as core strategic drivers, ensuring growth aligns with sustainability imperatives.      |
| Human-Centric AI and Digital Transformation | Decision-Making                   | Leveraging data-driven insights and ethical principles to make balanced choices on technology adoption, privacy, and inclusion.   |
| Innovation Ecosystems                       | Relationship Building             | Forging trust-based, cross-sector partnerships that accelerate innovation and broaden legitimacy.                                 |
| Future-Ready Policy and Systemic Change     | Strategic Vision                  | Anticipating policy shifts, envisioning long-term organisational positioning, and integrating agility into strategic direction.   |
| Trust, Equity and Inclusive Growth          | Systems Thinking                  | Understanding interdependencies between social, economic, technological, and environmental systems to design equitable solutions. |

*Table 1. Operationalizing the author's SHIFT Model through Future-Ready Leadership.  
(Source: Own elaboration)*

On one side of the table are the five disruptive forces captured in the author's SHIFT Model—sustainability and green transition, human-centric AI and digital transformation, innovation ecosystems, future-ready policy and systemic change, and trust, equity and inclusive growth. These

forces define the external environment in which organisations and societies now operate. The middle layer highlights the dimensions of the author's Future-Ready Leadership Framework—strategic vision, decision-making, impact-driven actions, relationship building, and systems thinking. These capabilities act as the connective links, enabling leaders to translate disruption into opportunity. Thus, this mapping shows that future-ready leadership is not an abstract concept but a targeted response to tangible global forces. Each dimension reinforces the leader's ability to navigate complexity, balance competing priorities, and design systems that are fit for both current realities and future demands. If the SHIFT Model maps the forces of change and the Future-Ready Leadership Framework defines the capabilities required, the next question is who can embody these capabilities in practice. Leadership today is still dominated by hierarchical, male-centric models, leaving a gap at the very moment when diversity and inclusivity are most needed. The following chapter examines how female leadership responds to this challenge, and why it is essential for shaping the new economy.

## 4 Female Leadership for the New Economy

When leadership tables lack diversity, the systems they govern tend to replicate exclusion. AI tools built without diverse inputs risk embedding historical bias (UNESCO, OECD, and IDB, 2022). Green transitions that ignore social justice and gender equity risk losing legitimacy and public trust (Raworth, 2017). For example, in emerging markets, where informal economies and governance gaps persist, the exclusion of women from decision-making perpetuates systemic underperformance and missed opportunities (Shinbrot *et al.*, 2019).

Therefore, exclusion is not just an ethical concern, it is a strategic risk. Economies that fail to integrate inclusive leadership into their core governance will struggle to deliver credible, adaptable, and future-fit systems (Hunt *et al.*, 2020; McKinsey & Company and LeanIn.Org, 2024). The new economy, driven by sustainability imperatives, AI transformation, and systemic shifts, demands leadership that is both representative and responsive to diverse stakeholder needs (Glass and Cook, 2017).

### 4.1 The leadership gap in a changing world

Despite decades of advocacy and incremental progress, leadership structures in the green and digital economy remain overwhelmingly male-dominated and technocratic. Women are significantly underrepresented in decision-making roles, even as they enter the workforce and higher education in greater numbers than men. Globally, women account for over 40% of the workforce, yet their representation in senior leadership plateaus at less than 30% (World Economic Forum, 2025). This disconnect between educational attainment and leadership participation reflects a persistent limited pipeline, where systemic barriers prevent women's skills and qualifications from translating into positions of influence (European Women on Boards, 2025; World Economic Forum, 2025).

The leadership gap is particularly evident in transformative sectors. In artificial intelligence and digital technologies, women still represent fewer than 20% of professionals, and their share shrinks further in technical and leadership roles (UNESCO, OECD, and IDB, 2022; World Economic Forum, 2025). While some narrowing of the gender gap has been observed in emerging economies and among younger cohorts, women remain underrepresented at senior levels, where strategic decisions about AI governance and sustainability integration are made (World Economic Forum, 2025). In sustainability governance, women are often clustered in communications or CSR functions but remain scarce in strategic domains such as energy, finance, and infrastructure (Binder, 2024; European Women on Boards, 2025; World Economic Forum, 2025). Moreover, women remain underrepresented in Industry 4.0 fields such as IT, physics, and engineering, facing persistent barriers in accessing technical and leadership roles (Serrano *et al.*, 2023).

This underrepresentation is not merely a matter of fairness; it has measurable consequences for innovation, governance, and resilience. Evidence shows that diverse leadership teams are more effective at anticipating risks, managing crises, and building stakeholder trust (Glass, Cook and

Ingersoll, 2015; Hunt *et al.*, 2020). Companies with more women executives display stronger ESG performance, higher quality sustainability reporting, and enhanced legitimacy in stakeholder engagement (Cicchiello *et al.*, 2021; Pierli, Murmura and Palazzi, 2022). Even in corporate finance, studies show that female executives influence risk-taking behaviour in strategic decisions such as cross-border mergers and acquisitions, often moderating excessive risk and pushing for stronger governance mechanisms (Jing *et al.*, 2025). At the macro level, (Gallup, 2025) highlights that economies failing to close gender gaps in leadership bear a hidden cost in the form of lost productivity, weaker innovation, and slower long-term growth.

The persistence of these gaps reflects structural inefficiencies in translating women's participation into leadership. Legal frameworks and diversity policies alone are insufficient; implementation gaps remain wide, particularly in contexts of AI-driven disruption and green transition (World Economic Forum, 2025). The result is an economy in which leadership continues to replicate exclusion, weakening legitimacy at precisely the moment when trust and adaptability are most essential (Whitehead *et al.*, 2025).

Closing this gap is therefore more than a moral imperative, it is a strategic necessity. Female leaders bring a set of competencies that are directly aligned with the demands of the new economy, from systems thinking and ethical foresight to collaborative intelligence (Eagly and Johannesen-Schmidt, 2001; Adams and Funk, 2012; Gamberini and Pluchino, 2024). The next subchapter explores these distinctive contributions and shows how they map onto the macro forces of the SHIFT Model and the dimensions of Future-Ready Leadership.

## 4.2 What female leaders bring to the new economy

The contribution of female leaders to the new economy is not defined by a single competency, but by a blend of perspective, approach, and lived experience that equips them to navigate complexity with nuance and foresight (Adams and Funk, 2012; Glass and Cook, 2017). Research further highlights that women's leadership traits—such as empathy, collaboration, and intercultural diplomacy—are especially valuable in addressing the challenges of Industry 4.0 (Serrano *et al.*, 2023). These strengths align closely with the macro forces and dimensions of the author's SHIFT Model and Future-Ready Leadership Framework, positioning women leaders as uniquely equipped to drive transformation:

- i. In advancing the Sustainability and Green Transition dimension, female leaders frequently take a long-term, impact-oriented approach, resisting short-term trade-offs that undermine environmental or social objectives. Studies show that women in leadership are more likely to integrate sustainability into core business models, link ESG objectives to executive performance, and push for transparent reporting on environmental impact (Adams and Funk, 2012; Cicchiello *et al.*, 2021; Pierli, Murmura and Palazzi, 2022). This approach aligns directly with the Impact-Driven Action dimension of future-ready leadership, where decisions are not only measured by financial return but also by their contribution to the organisation's broader purpose and societal role;
- ii. Within the scope of Human-Centric AI and Digital Transformation, female leaders tend to place a strong emphasis on ethical guardrails, inclusivity, and stakeholder protection. Research shows that women are more likely to question data biases, seek diverse input in system design, and balance innovation with safeguards for privacy, fairness, and accessibility (Glass, Cook and Ingersoll, 2015; Hunt *et al.*, 2020; UNESCO, OECD, and IDB, 2022). This orientation supports the Decision-Making dimension by ensuring that technological adoption is guided by both rigorous analysis and ethical responsibility;
- iii. When building Innovation Ecosystems, female leaders bring a relational style that prioritises trust, collaboration, and shared value creation. Such leaders often act as connectors between sectors, disciplines, and geographies, enabling innovations to move from pilot projects to scalable solutions (Westermann, Ashby and Pretty, 2005; Brammer, Millington and Pavelin, 2007; Binder, 2024). This strength underpins the Relationship Building dimension of future-

ready leadership, where durable partnerships are essential for navigating an increasingly networked economy;

- iv. When looking at Future-Ready Policy and Systemic Change, women leaders frequently exhibit a stakeholder-oriented approach to strategic vision, one that anticipates the long-term societal and environmental implications of policy decisions. They are more inclined to champion inclusive governance structures, advocate for equitable policy reforms, and integrate multiple stakeholder perspectives into strategic planning (Francis *et al.*, 2021; Adams *et al.*, 2023; European Women on Boards, 2025). This aligns directly with the Strategic Vision dimension, which calls for leadership that can see beyond immediate operational concerns to design resilient systems for the future;
- v. Finally, in driving Trust, Equity and Inclusive Growth, female leaders often demonstrate the ability to see the interconnections between social, economic, technological, and environmental dynamics. This competency enables them to design solutions that address root causes rather than symptoms, ensuring that growth is inclusive and that benefits are widely shared (Raworth, 2017; Shinbrot *et al.*, 2019; Birsan *et al.*, 2022). In contexts where stakeholder legitimacy is a decisive factor in the success of both AI and sustainability initiatives, this systems-based perspective is a critical asset.

To show how female leadership capabilities respond directly to the demands of the new economy, **Table 2** presents the author's mapping of each SHIFT force to its corresponding Future-Ready Leadership dimension and the distinctive contribution women leaders bring to that domain.

| Shift Forces                                | Future-Ready Leadership Dimensions | Female leadership Contribution  |
|---|------------------------------------|---|
| Sustainability and Green Transition         | Impact-Driven Actions              | Female leaders emphasise long-term sustainability over short-term gains, integrating environmental and social impact into performance metrics.                    |
| Human-Centric AI and Digital Transformation | Decision-Making                    | Women in leadership tend to adopt more ethical, inclusive decision-making processes, balancing technological innovation with fairness and stakeholder trust.      |
| Innovation Ecosystems                       | Relationship Building              | Female leaders excel at building trust-based, cross-sector partnerships, essential for collaborative innovation.  |
| Future-Ready Policy and Systemic Change     | Strategic Vision                   | Women often take a stakeholder-oriented approach to vision-setting, anticipating long-term policy impacts and integrating social equity into strategic direction. |
| Trust, Equity and Inclusive Growth          | Systems Thinking                   | Female leaders are adept at managing complex interdependencies, considering the broader social and environmental ecosystem in decision-making.                    |

*Table 2. Mapping Female Leadership Contributions onto the author's SHIFT Model and Future-Ready Leadership. (Source: Own elaboration)*

Across all five macro forces of the SHIFT Model and Future-Ready Leadership dimensions, the contributions of female leaders are not "soft" or peripheral, but strategic enablers of resilience, legitimacy, and innovation in the new economy. These competencies are essential to navigating the high-stakes trade-offs that define our era, ensuring that transformation is not only technologically advanced and environmentally sustainable, but also socially just and widely supported.

If this chapter shows why female leadership is essential for navigating the forces of the new economy, the next question is how these capabilities can be systematically embedded into governance and decision-making. Without structural mechanisms, the potential of inclusive leadership risks remaining

underutilised. Thus, the next chapter introduces a framework that translates leadership capabilities into actionable governance pillars, ensuring that transformation is not only envisioned but effectively led.

## 5 The NEXT Model: An Inclusive Leadership Framework

The preceding chapters established that the new economy—defined by the convergence of sustainability imperatives, AI-driven transformation, and systemic disruption—cannot be navigated effectively without leadership that is both future-ready and inclusive. The SHIFT Model mapped the five macro forces shaping this transformation, while the Future-Ready Leadership Framework translated these forces into capabilities leaders must develop to steer their organisations with vision, agility, and resilience (Santos *et al.*, 2025; Whitehead *et al.*, 2025). Yet recent work highlights the absence of frameworks that integrate Industry 4.0, the circular economy, and leadership, revealing a critical research gap (Gatell and Avella, 2023) that this paper seeks to address.

Building on this, previous chapter demonstrated that female leaders bring unique and highly relevant competencies to the table, aligning with both the SHIFT forces and the Future-Ready Leadership dimensions. However, without structural mechanisms to embed these competencies into governance and decision-making systems, their transformative potential remains underutilised. This chapter responds to this challenge by operationalising inclusive leadership within the governance architecture of the new economy.

### 5.1 The five strategic pillars of the NEXT model

Developed by the author, the NEXT Model translates the need for inclusive leadership into practice by embedding gender-inclusive governance within the architecture of the green and digital economy. Thus, it offers a transformational framework designed for the complexities of the new economy, addressing both the leadership gap and the systemic risks highlighted in previous chapters. These risks include the replication of bias in AI systems, the loss of legitimacy in green transitions without social inclusion, and the underperformance of economies that fail to harness diverse leadership (Raworth, 2017; UNESCO, OECD, and IDB, 2022; McKinsey & Company and LeanIn.Org, 2024).

To respond to these challenges, the NEXT Model advances five strategic pillars to embed gender-inclusive leadership into governance structures for AI, sustainability, and beyond:

- i. Governance Audits: involves a systematic review of the diversity, representativeness, and inclusivity of decision-making bodies across corporate boards, regulatory agencies, and civic institutions. Evidence from global board diversity studies shows that diverse leadership improves innovation quality, stakeholder legitimacy, and ESG performance (Cicchiello *et al.*, 2021; Adams *et al.*, 2023). Thus, it ensures that leadership reflects the stakeholder base it serves, which is critical in building public trust during transitions that are both technologically and socially disruptive;
- ii. Ethics-by-Design: embeds inclusive values, fairness, and societal impact considerations from the earliest stages of AI system development, digital policy formation, and green technology innovation. Research on AI ethics underscores that ethical principles retrofitted late in the process are less effective (Floridi *et al.*, 2021). Female leaders, with their stakeholder-oriented decision-making, are well positioned to champion this approach (Glass and Cook, 2017). Thus, it allows for equitable access to green technologies and ensuring vulnerable communities benefit from green adaptation measures;
- iii. Impact Metrics: traditional KPIs focus heavily on financial outcomes and, in sustainability contexts, environmental performance. The NEXT Model expands this to include gender representation, stakeholder trust, social legitimacy, and inclusivity as core performance indicators. Studies show that organisations with gender-diverse leadership teams are more likely to prioritise these broader impact metrics and link them to executive accountability

(Hunt *et al.*, 2020; Pierli, Murmura and Palazzi, 2022). This approach reframes “success” to capture the multidimensional value organisations must deliver in the new economy;

- iv. Coalition Platforms: facilitates collaboration across sectors, geographies, and disciplines, enabling women to co-lead initiatives in green innovation, AI policy, and systemic transformation. Evidence from innovation ecosystem research shows that diverse leadership within coalitions enhances problem-solving capacity, accelerates scaling of solutions, and improves legitimacy with stakeholders (Westermann, Ashby and Pretty, 2005; Brammer, Millington and Pavelin, 2007). Thus, it makes a move beyond networking to active co-governance of transformation agendas;
- v. Capability Building: includes formal leadership training, mentorship programs, and cross-sector secondments to build systems thinking and strategic governance skills (Francis *et al.*, 2014; Binder, 2024). Pilot programmes embedding entrepreneurship and leadership training in higher education demonstrate that targeted capability-building initiatives can accelerate women’s entry into Industry 4.0 entrepreneurship and leadership (Serrano *et al.*, 2023). By strengthening the competencies required for Future-Ready Leadership, this pillar ensures that women leaders are not only present but fully equipped to shape the new economy.

**Figure 3** presents the author’s NEXT Model, illustrating how its five pillars connect to the leadership capabilities required to govern effectively the macro forces of the new economy. Together, these pillars transform Future-Ready leadership from an aspiration into a structured framework for action. They demonstrate that addressing today’s systemic risks—bias in AI, fragile legitimacy in green transitions, and underutilised leadership capital—requires not only individual capabilities but also institutionalised mechanisms of governance.

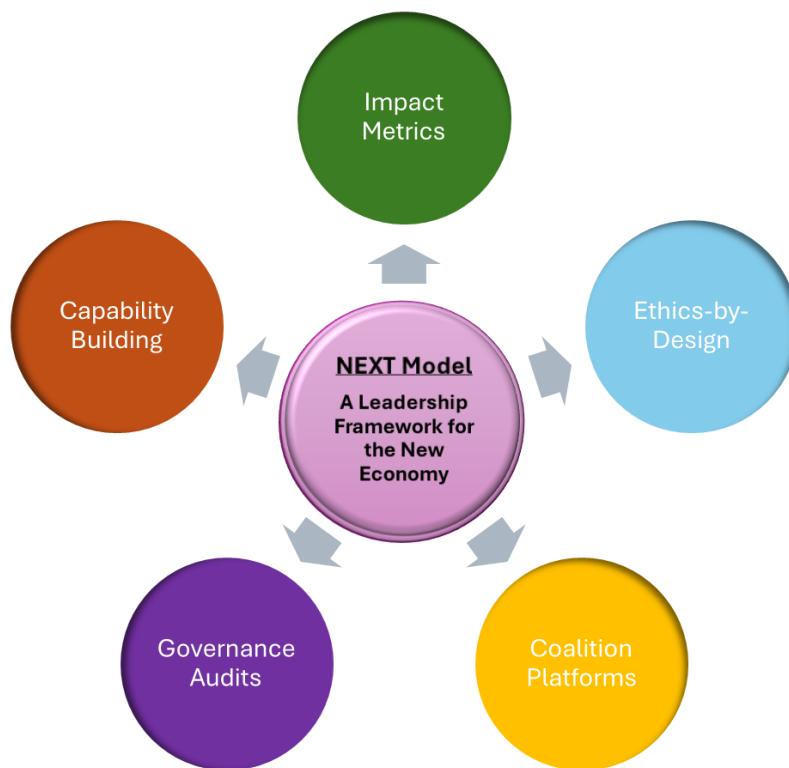


Figure 3. The NEXT Model. (Source: Own elaboration)

Yet the true strength of the NEXT Model lies in how it complements and completes the frameworks introduced earlier. To fully understand its contribution, it is necessary to examine how the SHIFT

forces, the dimensions of Future-Ready Leadership, and the structural interventions of NEXT align into a coherent model for leading transformation.

## 5.2 Connecting SHIFT, Future-Ready Leadership, and NEXT

As outlined above, the author's frameworks—the SHIFT Model, the Future-Ready Leadership Framework, and the NEXT Model—are designed to work together. The NEXT Model does not replace the frameworks introduced earlier; it completes them:

- i. The SHIFT Model identifies what forces are shaping the new economy;
- ii. Future-Ready Leadership defines what capabilities leaders need to navigate these forces;
- iii. The NEXT Model translates these capabilities into structural interventions that enable women leaders to lead transformation effectively.

This layered approach ensures that leadership for the new economy is not merely conceptual but embedded into institutional practice. It recognises that external disruption (SHIFT) requires corresponding internal capacities (Future-Ready Leadership), which in turn must be institutionalised through systemic mechanisms (NEXT). While, for example Guzmán et al. (2020) mapped leadership characteristics and skills needed for Industry 4.0, the pace of disruption and systemic interdependencies in the new economy demand an expanded framework that integrates inclusivity, sustainability, and governance. **Table 3** demonstrates this integration, linking the author's SHIFT forces with their corresponding Future-Ready Leadership dimensions, the contribution female leaders bring, and the governance pillars of the NEXT Model that anchor these contributions in practice.

| SHIFT Forces                                | Future-Ready Leadership Dimensions | Female Leadership Contribution  | NEXT Model Pillars  |
|---|------------------------------------|---|---------------------|
| Sustainability and Green Transition         | Impact-Driven Actions              | Emphasise long-term sustainability over short-term gains, integrating environmental and social goals into organisational performance. | Impact Metrics      |
| Human-Centric AI and Digital Transformation | Decision-Making                    | Champion ethical, inclusive adoption of AI, safeguarding privacy, fairness, and accessibility.  | Ethics-By-Design    |
| Innovation Ecosystems                       | Relationship Building              | Forge trust-based, cross-sector partnerships that accelerate innovation and broaden legitimacy.                                       | Coalition Platforms |
| Future-Ready Policy and Systemic Change     | Strategic Vision                   | Ensure decision-making bodies are diverse and representative, enhancing policy foresight and legitimacy.                              | Governance Audits   |
| Trust, Equity and Inclusive Growth          | Systems Thinking                   | Develop leadership pipelines and digital fluency to design equitable, system-wide solutions.  | Capability Building |

*Table 3. Linking the author's SHIFT → Future-Ready Leadership → NEXT Model in the Context of Female Leadership. (Source: Own elaboration)*

Furthermore, the lack of a robust leadership pipeline, highlighted in the Global Leadership Forecast 2025 (Development Dimensions International, 2025), underscores the urgency of embedding inclusive leadership frameworks such as NEXT.

Thus, the author's NEXT Model provides a scalable and actionable governance tool for embedding inclusive leadership into the core of digital and green transitions:

- For policymakers, it offers a framework to align regulatory oversight with diversity and inclusion goals;
- For organizations, it serves as a blueprint to align leadership structures with sustainability, AI ethics, and stakeholder legitimacy imperatives;
- And for the broader economy, it represents a pathway to ensure that transformation is not only technologically advanced and environmentally sustainable, but also socially just and widely supported.

Taken together, these insights highlight that the challenge is no longer identifying what must change, but ensuring that leadership systems are capable of driving and sustaining that change. This sets the stage for the final part, which distils the core conclusions of the study and offers concrete recommendations for practice, policy, and future research.

### 5.3 Conclusions and Recommendations

In conclusion, leadership in the new economy cannot be guided by outdated paradigms or measured by yesterday's metrics. As societies design the systems that will shape coming decades, from green infrastructure to AI governance, the central question of who leads the future must be addressed directly. This paper has argued that female and inclusive leadership is not symbolic but a strategic enabler of resilience, legitimacy, and complexity management.

The combined author-developed SHIFT–Future-Ready–NEXT frameworks, introduced in this paper, provide both the map and the compass: the SHIFT Model identifies the macro forces reshaping the economy; the Future-Ready Leadership Framework specifies the capabilities leaders require; and the NEXT Model embeds these capabilities into governance through diversity, ethics, and systemic thinking.

This paper contributes by:

- Framing women's underrepresentation as a governance gap with direct consequences for resilience and legitimacy;
- Integrating fragmented literatures into the original, author-developed, SHIFT–Future-Ready–NEXT frameworks, linking macro forces, leadership capabilities, and governance;
- Positioning female leadership as a strategic enabler, embedding inclusivity into the foundations of resilience and sustainable transformation.

Future research should test the SHIFT–NEXT linkage empirically, explore sector-specific applications, and use longitudinal studies to track how inclusive leadership evolves through transformation. Ultimately, the leadership challenge is not only to innovate, but to build trust, include all stakeholders, and safeguard long-term societal and environmental wellbeing. *Who leads the future is therefore not just a rhetorical question, it is the defining strategic choice of our time.*

## References

Adams, K. *et al.* (2023) 'Female board representation and coupled open innovation: Evidence from emerging market multinational enterprises,' *Technovation*, 124, p. 102749. <https://doi.org/10.1016/j.technovation.2023.102749>.

Adams, R.B. and Funk, P. (2012) 'Beyond the glass ceiling: Does gender matter?,' *Management Science*, 58(2), pp. 219–235. <https://doi.org/10.1287/mnsc.1110.1452>.

Alshaibani, E., Bakir, A. and Al-Atwi, A. (2024) 'The impact of leadership behaviors on organizational innovative performance and learning in AI-driven Industry 5.0 environments,' *Development in Learning Organizations an International Journal* [Preprint]. <https://doi.org/10.1108/dlo-06-2024-0159>.

Bennett, N. and Lemoine, G.J. (2014) 'What a difference a word makes: Understanding threats to performance in a VUCA world,' *Business Horizons*, 57(3), pp. 311–317. <https://doi.org/10.1016/j.bushor.2014.01.001>.

Binder, J. (2024) *Women leading the way in sustainability: Shaping a Greener Future - The European Business Review*. <https://www.europeanbusinessreview.com/women-leading-the-way-in-sustainability-shaping-a-greener-future/> (Accessed: January 15, 2025).

Birsan, A. et al. (2022) 'Female Entrepreneurship Model, a Sustainable solution for crisis resilience,' *European Journal of Sustainable Development*, 11(2), p. 39. <https://doi.org/10.14207/ejsd.2022.v11n2p39>.

Brammer, S., Millington, A. and Pavelin, S. (2007) 'Gender and ethnic diversity among UK corporate boards,' *Corporate Governance an International Review*, 15(2), pp. 393–403. <https://doi.org/10.1111/j.1467-8683.2007.00569.x>.

Breque, M. et al. (2021) *Industry 5.0 Towards a sustainable, human-centric and resilient European industry* [PDF]. First edition, *Publications Office of the European Union*. First edition. Policy brief. European Commission. <https://doi.org/10.2777/308407>.

Butlin, J. (1989) 'Our common future. By World commission on environment and development. (London, Oxford University Press, 1987, pp.383 £5.95.)' *Journal of International Development*, 1(2), pp. 284–287. <https://doi.org/10.1002/jid.3380010208>.

Cascio, J. (2020) 'Facing the Age of Chaos,' *Medium*, 29 April. <https://medium.com/@cascio/facing-the-age-of-chaos-b00687b1f51d> (Accessed: August 6, 2025).

Cicchiello, A.F. et al. (2021) 'Gender diversity on corporate boards: How Asian and African women contribute on sustainability reporting activity,' *Gender in Management an International Journal*, 36(7), pp. 801–820. <https://doi.org/10.1108/gm-05-2020-0147>.

Development Dimensions International (2025) *Global Leadership Forecast 2025*. Development Dimensions International. <https://www.ddi.com/research/global-leadership-forecast-2025> (Accessed: August 4, 2025).

Eagly, A.H. and Johannesen-Schmidt, M.C. (2001) 'The leadership styles of women and men,' *Journal of Social Issues*, 57(4), pp. 781–797. <https://doi.org/10.1111/0022-4537.00241>.

European Women on Boards (2025) *BOARD BARRIERS: The surprising obstacles facing women at the top and how to overcome them*. European Women on Boards. <https://europeanwomenonboards.eu/wp-content/uploads/2025/02/ewob-research-report-2025.pdf> (Accessed: August 1, 2025).

Floridi, L. et al. (2021) 'An ethical framework for a good AI society: opportunities, risks, principles, and recommendations,' in *Ethics, Governance, and Policies in Artificial Intelligence*. Springer, Cham, pp. 19–39. [https://doi.org/10.1007/978-3-030-81907-1\\_3](https://doi.org/10.1007/978-3-030-81907-1_3).

Francis, B. et al. (2014) 'Gender Differences in Financial Reporting Decision Making: Evidence from Accounting Conservatism,' *Contemporary Accounting Research*, 32(3), pp. 1285–1318. <https://doi.org/10.1111/1911-3846.12098>.

Francis, B. et al. (2021) 'Do activist hedge funds target female CEOs? The role of CEO gender in hedge fund activism,' *Journal of Financial Economics*, 141(1), pp. 372–393. <https://doi.org/10.1016/j.jfineco.2020.07.019>.

Gallup (2025) *State of the Global Workplace: 2025 Report: Understanding Employees, Informing Leaders*. Gallup. <https://www.gallup.com/workplace/349484/state-of-the-global-workplace.aspx> (Accessed: August 8, 2025).

Gamberini, L. and Pluchino, P. (2024) 'Industry 5.0: A comprehensive insight into the future of work, social sustainability, sustainable development, and career,' *Australian Journal of Career Development*, 33(1), pp. 5–14. <https://doi.org/10.1177/10384162241231118>.

Gatell, I.S. and Avella, L. (2023) 'Impact of Industry 4.0 and circular economy on lean culture and leadership: Assessing digital green lean as a new concept,' *European Research on Management and Business Economics*, 30(1), p. 100232. <https://doi.org/10.1016/j.iedeen.2023.100232>.

Glass, C. and Cook, A. (2017) 'Do women leaders promote positive change? Analyzing the effect of gender on business practices and diversity initiatives,' *Human Resource Management*, 57(4), pp. 823–837. <https://doi.org/10.1002/hrm.21838>.

Glass, C., Cook, A. and Ingersoll, A.R. (2015) 'Do women leaders promote sustainability? Analyzing the effect of corporate governance composition on environmental performance,' *Business Strategy and the Environment*, 25(7), pp. 495–511. <https://doi.org/10.1002/bse.1879>.

Guzmán, V.E. et al. (2020) 'Characteristics and skills of leadership in the context of Industry 4.0,' *Procedia Manufacturing*, 43, pp. 543–550. <https://doi.org/10.1016/j.promfg.2020.02.167>.

Henley Business School (2025) *Leadership Futures: Advancing into Industry 5.0: Unlocking the potential for enhanced ethics, sustainability and human-centricity*. Henley Business School. <https://www.henley.ac.uk/leadership-futures> (Accessed: August 10, 2025).

Hunt, V. et al. (2020) *Diversity wins: How inclusion matters*. McKinsey & Company. <https://www.mckinsey.com/featured-insights/diversity-and-inclusion/diversity-wins-how-inclusion-matters#/> (Accessed: August 19, 2025).

Jing, S. et al. (2025) 'Have female executives made a Difference?—The impact of female executives on Cross-Border mergers and acquisitions in listed companies,' *International Review of Economics & Finance*, p. 103881. <https://doi.org/10.1016/j.iref.2025.103881>.

Karwan, D., Hariri, H. and Ridwan, R. (2021) *Visionary Leadership: What, Why, and How*. <https://doi.org/10.4108/eai.16-10-2020.2305217>.

Lasi, H. et al. (2014) 'Industry 4.0,' *Business & Information Systems Engineering*, 6(4), pp. 239–242. <https://doi.org/10.1007/s12599-014-0334-4>.

McKinsey & Company and LeanIn.Org (2024) *Women in the workplace*. <https://www.mckinsey.com/featured-insights/diversity-and-inclusion/women-in-the-workplace> (Accessed: March 20, 2025).

Meadows, D. (2008) *Thinking in Systems: A Primer* [Kindle]. Chelsea Green Publishing.

Nahavandi, S. (2019) 'Industry 5.0—A Human-Centric solution,' *Sustainability*, 11(16). <https://doi.org/10.3390/su11164371>.

Pierli, G., Murmura, F. and Palazzi, F. (2022) 'Women and Leadership: How do women leaders contribute to companies' sustainable choices?,' *Frontiers in Sustainability*, 3. <https://doi.org/10.3389/frsus.2022.930116>.

Raworth, K. (2017) *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* [Kindle]. Chelsea Green Publishing.

Rejeb, A. et al. (2025) 'When Industry 5.0 Meets the Circular Economy: A Systematic Literature Review,' *Circular Economy and Sustainability*, 5, pp. 2621–2652. <https://doi.org/10.1007/s43615-025-00570-y>.

Russell, S. and Norvig, P. (2021) *Artificial Intelligence: A Modern Approach* [Kindle]. 4th edn. Pearson.

Santos, C.F. *et al.* (2025) 'Leadership Perspectives on the Transition from Industry 4.0 to Industry 5.0: A Broad Systematic Literature Review,' *Journal of Scientometric Research*, 14(2), pp. 467–478. <https://doi.org/10.5530/jscires.20251691>.

Schwab, K. (2017) *The Fourth Industrial Revolution* [Kindle]. Crown Currency.

Serrano, D.R. *et al.* (2023) 'Women as Industry 4.0 entrepreneurs: unlocking the potential of entrepreneurship in Higher Education in STEM-related fields,' *Journal of Innovation and Entrepreneurship*, 12(1). <https://doi.org/10.1186/s13731-023-00346-4>.

Shinbrot, X.A. *et al.* (2019) 'Unlocking women's sustainability leadership potential: Perceptions of contributions and challenges for women in sustainable development,' *World Development*, 119, pp. 120–132. <https://doi.org/10.1016/j.worlddev.2019.03.009>.

United Nations (2015) *Transforming our world: the 2030 Agenda for Sustainable Development*. United Nations. <https://sdgs.un.org/2030agenda> (Accessed: August 2, 2025).

UNESCO, OECD, and IDB (2022) *The Effects of AI on the Working Lives of Women*. UNESCO. <https://unesdoc.unesco.org/ark:/48223/pf000380861?posInSet=11&queryId=f0e6af5e-2c27-4a9b-9e22-21d5c843dd52> (Accessed: August 1, 2025).

Wang, L., Jin, X. and Yoo, J.J. (2024) 'The Process of Visionary Leadership Increases Innovative Performance among IT Industry 4.0 for SMEs for Organizational Sustainability: Testing the Moderated Mediation Model,' *Sustainability*, 16(19), p. 8690. <https://doi.org/10.3390/su16198690>.

Westermann, O., Ashby, J. and Pretty, J. (2005) 'Gender and social capital: The importance of gender differences for the maturity and effectiveness of natural resource management groups,' *World Development*, 33(11), pp. 1783–1799. <https://doi.org/10.1016/j.worlddev.2005.04.018>.

Whitehead, J. *et al.* (2025) 'Strategic Leadership 5.0: Reality or illusion?,' *Journal of the Knowledge Economy* [Preprint]. <https://doi.org/10.1007/s13132-025-02785-8>.

World Economic Forum (2025) *Global Gender Gap Report 2025*. World Economic Forum. <https://www.weforum.org/publications/global-gender-gap-report-2025/> (Accessed: August 3, 2025).

Xu, X. *et al.* (2021) 'Industry 4.0 and Industry 5.0—Inception, conception and perception,' *Journal of Manufacturing Systems*, 61, pp. 530–535. <https://doi.org/10.1016/j.jmsy.2021.10.006>.