



Technology Governance Models for Ethical Future Development

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Abstract

The accelerating development of artificial intelligence, autonomous systems, biotechnology, digital platforms, advanced data analytics, and other emerging technologies has intensified the need for governance models capable of directing technological change toward ethically defensible and socially sustainable outcomes. Conventional regulatory mechanisms frequently operate after technologies have entered widespread use, whereas contemporary technological systems may generate complex effects during design, training, deployment, and continuous adaptation. This conceptual research article examines technology governance models for ethical future development with particular attention to accountability, transparency, human oversight, stakeholder participation, anticipatory governance, and responsible innovation. The study adopts a structured conceptual synthesis of established scholarship on technology governance, responsible research and innovation, artificial intelligence ethics, risk governance, and sociotechnical change.

The analysis identifies risk-based governance, anticipatory governance, participatory governance, adaptive governance, and responsible innovation as complementary rather than mutually exclusive approaches. Their effectiveness depends on the characteristics and social consequences of the technology being governed. The study argues that ethically robust governance cannot be reduced to regulatory compliance alone; it requires institutional capacity to anticipate consequences, assign responsibility, incorporate affected stakeholders, monitor technological performance, and revise interventions when evidence changes. The article concludes that future-oriented technology governance should combine enforceable safeguards with adaptive oversight and participatory mechanisms so that technological progress remains compatible with human agency, social justice, public accountability, and sustainable development.

Keywords: Technology Governance; Ethical Technology; Responsible Innovation; Emerging Technologies; Anticipatory Governance; Artificial Intelligence Ethics; Accountability

1. Introduction

Technological innovation increasingly influences economic organization, public administration, healthcare, communication, mobility, education, security, and everyday social interaction. Artificial intelligence and other data-intensive technologies can extend analytical capabilities and automate complex activities, while autonomous systems and digitally connected infrastructures can alter established relationships between human judgment and machine-mediated action. The significance of these developments extends beyond technical performance because technological systems can

redistribute opportunities, risks, responsibilities, and decision-making power. Governance has therefore become a central consideration in determining not merely whether new technologies can be developed, but under what institutional and ethical conditions they should be designed and deployed.

Technology governance refers broadly to the institutional arrangements, regulatory instruments, standards, norms, organizational practices, and participatory mechanisms through which technological development is directed and supervised. Effective governance must operate across the technology lifecycle because ethical concerns may emerge during problem formulation, data collection, system design, implementation, monitoring, and eventual withdrawal. Issues involving privacy, discrimination, opacity, safety, environmental consequences, cybersecurity, and unequal access cannot always be addressed adequately through retrospective intervention. Governance consequently needs preventive and anticipatory capacities alongside mechanisms for accountability when adverse outcomes occur.

Ethical future development introduces an additional requirement: technological progress should remain compatible with legitimate societal values rather than being evaluated exclusively through efficiency, profitability, or technical capability. Responsible innovation scholarship has emphasized anticipation, reflexivity, inclusion, and responsiveness as important dimensions of innovation governance. Similarly, contemporary discussions of AI ethics emphasize human autonomy, prevention of harm, fairness, explicability, and accountability. These perspectives suggest that governance should establish substantive safeguards while creating institutional processes through which emerging risks and value conflicts can be identified before they become deeply embedded in technological infrastructures.

A single universal governance model is unlikely to address the diversity of contemporary technologies and their applications. High-risk autonomous decision systems, consumer digital platforms, medical technologies, industrial automation, and experimental innovations generate different combinations of uncertainty, societal exposure, and potential harm. The central governance problem is therefore one of designing proportionate and adaptive arrangements that combine legal accountability, technical assurance, ethical assessment, stakeholder participation, and continuous learning. Against this background, the present study examines major technology governance models and considers how their complementary characteristics can support ethical future development.

2. Review of Literature

2.1 From Technology Regulation to Anticipatory Governance

Earlier approaches to technology governance frequently relied on regulatory intervention after technological applications and associated risks had become sufficiently visible. Such approaches remain necessary for establishing legal obligations, safety requirements, and enforceable accountability. However, rapid technological development has exposed the limitations of exclusively reactive governance. Collingridge's analysis of technological control demonstrated a persistent dilemma: interventions are comparatively easier during early technological development when consequences are uncertain, while greater knowledge often arrives only after technologies become socially and economically entrenched. This problem remains highly relevant to emerging digital and autonomous technologies.

Anticipatory governance addresses this difficulty by incorporating foresight, interdisciplinary assessment, stakeholder engagement, and institutional learning before technological trajectories become difficult to modify. Guston conceptualized anticipatory governance as a capacity for understanding and

shaping emerging technologies rather than predicting their future with certainty. This orientation shifts governance toward continuous examination of plausible consequences, alternative development pathways, and societal values. It therefore provides an important foundation for future-oriented ethical technology management.

2.2 Responsible Innovation and Ethical Technology Design

Responsible innovation literature has expanded technology governance by questioning not only the risks associated with innovation but also its purposes, beneficiaries, and societal direction. Stilgoe, Owen, and Macnaghten proposed anticipation, reflexivity, inclusion, and responsiveness as central dimensions of responsible innovation. These principles encourage researchers, firms, policymakers, and other actors to examine assumptions underlying technological development and to respond meaningfully to emerging evidence and public concerns.

Ethical technology design complements this institutional perspective by embedding normative considerations within technological development itself. Privacy, fairness, explainability, accessibility, safety, and human agency can be considered during system design rather than addressed exclusively through downstream correction. Nevertheless, ethical principles require operational mechanisms to influence actual decisions. Governance models therefore need procedures for impact assessment, documentation, auditing, oversight, stakeholder consultation, and remediation if broad ethical commitments are to translate into accountable technological practice.

2.3 Adaptive and Participatory Models of Technology Governance

Adaptive governance recognizes that technological uncertainty prevents policymakers from anticipating every future consequence at the beginning of regulation. Rather than treating governance arrangements as static, adaptive approaches incorporate monitoring, periodic reassessment, feedback, experimentation, and revision. Such flexibility is particularly relevant where technological systems change through software updates, machine learning, new applications, or evolving data environments. Adaptability, however, must remain bounded by clear rights and safety requirements so that regulatory flexibility does not become an absence of meaningful accountability.

Participatory governance addresses another limitation of purely expert-driven technology management by incorporating citizens, affected communities, professional groups, civil society organizations, and other stakeholders into governance processes. Participation can reveal impacts that may be overlooked by developers or regulators and can improve the legitimacy of difficult decisions involving technological trade-offs. Its value depends on substantive influence rather than symbolic consultation. Consequently, participatory governance is most effective when institutions clearly identify how stakeholder contributions affect technology assessment, policy formation, implementation, and subsequent review.

3. Objectives of the Study

3.1 Examining the Role of Technology Governance Models in Ethical Technology Development

The primary objective of this study is to examine the role of technology governance models in guiding the development and implementation of emerging technologies according to ethical, social, and institutional principles. The research focuses on understanding how governance frameworks influence

technological decision-making, risk management, accountability mechanisms, and responsible innovation practices. As technologies such as artificial intelligence, autonomous systems, and advanced digital infrastructures become increasingly integrated into society, governance models are required to ensure that innovation progresses with appropriate consideration of human values and public interests.

Furthermore, this objective aims to analyse how different governance approaches contribute to ethical technology development. The study explores the importance of regulatory oversight, transparency mechanisms, stakeholder participation, and continuous evaluation in creating responsible technological ecosystems. It emphasizes that effective governance should not only control potential risks but also encourage innovation that produces sustainable and socially beneficial outcomes.

Key areas examined include:

- Technology governance models establish ethical directions for emerging technology development.
- Governance mechanisms improve accountability and transparency in technological systems.
- Responsible innovation frameworks support socially beneficial technological progress.
- Ethical assessment helps identify potential risks during technology development.
- Human-centred governance strengthens trust in emerging technologies.

3.2 Evaluating the Effectiveness of Governance Approaches for Managing Emerging Technology Risks

The second objective of this study is to evaluate the effectiveness of different technology governance approaches in managing risks associated with emerging technologies. The research examines risk-based governance, anticipatory governance, adaptive governance, participatory governance, and responsible innovation models to understand their contribution toward safer and more accountable technology development.

In addition, this objective investigates how governance mechanisms address challenges related to algorithmic decision-making, cybersecurity threats, privacy concerns, technological uncertainty, and social impacts. The study evaluates whether existing governance approaches provide sufficient flexibility to manage rapidly evolving technologies while maintaining enforceable standards for safety, fairness, and accountability.

Important governance evaluation areas include:

- Risk-based governance supports systematic identification of technological risks.
- Adaptive governance enables continuous improvement of regulatory approaches.
- Participatory models improve inclusion of diverse societal perspectives.
- Accountability frameworks clarify responsibility for technological outcomes.
- Ethical governance mechanisms improve public confidence in innovation.

3.3 Identifying Future Directions for Sustainable and Ethical Technology Governance

The third objective of this study is to identify future directions for developing sustainable and ethically responsible technology governance frameworks. The research examines how future governance models can integrate technological innovation with social responsibility, environmental sustainability, human rights protection, and long-term public value creation.

Additionally, this objective explores the need for international cooperation, interdisciplinary collaboration, advanced monitoring mechanisms, and flexible policy structures to manage future

technological developments. The study investigates how governance systems can become more proactive, transparent, and adaptive while supporting innovation across different technological domains.

Future development priorities include:

- Future governance models require proactive approaches for emerging technologies.
- International cooperation can improve consistency in technology governance.
- Continuous monitoring supports responsible technology evolution.
- Interdisciplinary collaboration strengthens governance decisions.
- Sustainable frameworks ensure technology benefits future generations.

4. Research Methodology

4.1 Research Design and Conceptual Framework

This study adopts a conceptual research design to examine technology governance models and their role in supporting ethical future development. The conceptual approach is appropriate because the research focuses on analysing theoretical perspectives, governance frameworks, responsible innovation principles, and emerging technology management approaches rather than conducting direct empirical investigations. The study integrates perspectives from technology policy, artificial intelligence governance, ethical innovation, regulatory studies, and sociotechnical systems research to understand how governance structures influence technological development.

The conceptual framework of the study is based on the relationship between technology development, governance mechanisms, ethical principles, stakeholder involvement, risk management, and societal outcomes. It considers technology governance as a multidimensional process involving regulation, institutional practices, technical standards, and social participation. The framework evaluates how governance models support ethical technology development through accountability, transparency, adaptability, safety assurance, and responsible decision-making.

4.2 Data Sources and Literature Analysis Approach

The study utilizes secondary data sources collected from peer-reviewed research articles, academic books, technology governance studies, responsible innovation literature, artificial intelligence ethics research, policy frameworks, and regulatory analysis. The literature-based methodology enables systematic examination of existing knowledge related to technology governance models, ethical technology development, emerging technology risks, and future governance requirements.

The literature analysis process involved identifying major themes related to governance approaches, ethical principles, regulatory mechanisms, technological risks, and institutional responses. The collected information was organized according to governance models, implementation strategies, benefits, and limitations. This thematic synthesis approach supported the identification of relationships between governance mechanisms and ethical technology outcomes.

4.3 Analytical Framework and Evaluation Parameters

The analytical framework evaluates technology governance models through multiple dimensions, including ethical responsibility, transparency, accountability, stakeholder participation, adaptability, safety management, and sustainability orientation. These parameters were selected because they represent essential characteristics of effective governance systems for emerging technologies.

The evaluation process considers both technological and institutional factors influencing governance effectiveness. Technological factors include artificial intelligence systems, autonomous technologies, digital platforms, data-driven applications, and automated decision systems. Institutional factors include regulatory capacity, policy coordination, organizational readiness, ethical standards, and stakeholder engagement mechanisms. This multidimensional framework enables comprehensive assessment of technology governance approaches.

4.4 Research Procedure and Interpretation Method

The research procedure followed a structured process involving identification of technology governance concepts, analysis of ethical governance models, evaluation of emerging technology challenges, and interpretation of future governance opportunities. Qualitative thematic analysis was applied to examine patterns within the selected literature and identify significant relationships between governance strategies and ethical technology development.

The interpretation process involved comparative analysis of different technology governance models and their contribution toward responsible innovation. The findings were synthesized to identify effective governance principles, implementation strengths, and potential improvement areas. Ethical considerations related to human autonomy, fairness, transparency, accountability, sustainability, and social responsibility were incorporated throughout the research process.

Table 1: Research Methodology Framework

Research Component	Description
Research Design	Conceptual research design based on technology governance and ethical innovation frameworks
Data Sources	Peer-reviewed studies, governance literature, AI ethics research, policy frameworks, and regulatory studies
Research Approach	Qualitative thematic analysis and conceptual synthesis
Evaluation Parameters	Accountability, transparency, ethics, participation, adaptability, safety, and sustainability
Interpretation Method	Comparative analysis of technology governance models and ethical development strategies

Table Interpretation: The methodology framework demonstrates that the study follows a structured conceptual approach by combining technology governance perspectives with ethical future development analysis. The selected research components support systematic evaluation of how governance models influence responsible innovation, risk management, transparency, and sustainable technological progress.

5. Analysis

5.1 Evaluation of Technology Governance Models for Ethical Development

The analysis indicates that technology governance models play a fundamental role in ensuring that emerging technologies develop within ethical, social, and institutional boundaries. As artificial intelligence, autonomous systems, biotechnology, and digital platforms continue to influence society, governance mechanisms provide essential structures for managing risks, improving accountability, and maintaining public trust. Effective governance models enable organizations and policymakers to guide technological innovation while considering broader social consequences.

The findings demonstrate that no single governance approach is sufficient for addressing the complexity of modern technologies. Risk-based governance provides mechanisms for identifying and controlling potential harms, while anticipatory governance supports early consideration of future consequences. Adaptive governance enables continuous improvement as technologies evolve, and participatory governance incorporates diverse societal perspectives. Therefore, integrated governance approaches are required to support ethical and sustainable technological development.

Major technology governance contributions include:

- Governance models establish ethical direction for technology development.
- Risk assessment frameworks improve technology safety management.
- Transparency mechanisms strengthen public accountability.
- Stakeholder participation improves governance legitimacy.
- Adaptive approaches support rapidly changing technologies.

5.2 Strategic Impact of Ethical Governance Mechanisms on Future Technologies

Ethical governance mechanisms significantly influence the responsible adoption and long-term sustainability of emerging technologies. The analysis reveals that principles such as fairness, transparency, human oversight, privacy protection, and accountability provide essential foundations for trustworthy technology ecosystems. These mechanisms help organizations identify potential social impacts and develop technologies that align with public expectations.

Furthermore, ethical governance supports innovation by creating clear principles for responsible experimentation and deployment. Organizations can improve technological acceptance when governance structures demonstrate commitment to safety, social responsibility, and public value. The strategic importance of ethical governance lies in balancing innovation opportunities with protection against unintended consequences.

Strategic benefits of ethical governance include:

- Ethical frameworks improve responsible technology adoption.
- Accountability systems clarify technological responsibilities.
- Transparency increases trust in complex technologies.
- Human-centred approaches protect societal values.
- Governance principles support sustainable innovation.

5.3 Comparative Assessment of Technology Governance Applications

The comparative assessment examines major technology governance applications, including risk-based governance, anticipatory governance, adaptive governance, participatory governance, and responsible

innovation frameworks. These approaches represent different strategies for managing emerging technologies and supporting ethical future development.

The analysis indicates that responsible innovation frameworks and adaptive governance models provide significant contributions because they combine ethical reflection with continuous improvement. Risk-based governance strengthens safety management, while participatory governance improves inclusion and legitimacy. Anticipatory governance supports proactive identification of future challenges. Therefore, combined governance approaches provide stronger foundations for ethical technology development.

Table 2: Comparative Analysis of Technology Governance Models

Governance Model	Primary Function	Ethical Benefit	Governance Contribution
Responsible Innovation Framework	Integrating ethics into innovation processes	Improved social alignment	Very High
Adaptive Governance Model	Continuous policy improvement	Better response to technological change	Very High
Risk-Based Governance	Managing technological risks	Enhanced safety protection	High
Participatory Governance	Including stakeholder perspectives	Increased legitimacy	High
Anticipatory Governance	Assessing future consequences	Proactive risk management	High

Table Interpretation: The table demonstrates that responsible innovation and adaptive governance models provide very high contributions because they combine ethical considerations with continuous improvement mechanisms. Risk-based, participatory, and anticipatory governance approaches further strengthen technology governance by improving safety, inclusion, and future-oriented decision-making.

6. Challenges

6.1 Rapid Technological Evolution, Regulatory Uncertainty, and Governance Adaptation Challenges

One of the major challenges associated with technology governance is the difficulty of developing governance frameworks that can effectively respond to rapidly evolving technological environments. Emerging technologies such as artificial intelligence, autonomous systems, biotechnology, and advanced digital platforms continue to develop faster than traditional regulatory processes. This creates uncertainty regarding how governance mechanisms should address new capabilities, unexpected outcomes, and changing patterns of technology use.

Furthermore, governance institutions often face difficulties in maintaining a balance between encouraging innovation and controlling potential risks. Overly restrictive approaches may limit technological progress, while insufficient oversight may allow harmful consequences to emerge. Effective governance requires adaptive frameworks that can evolve alongside technological developments while maintaining essential ethical and safety principles.

Major technological and regulatory challenges include:

- Governance frameworks must adapt to rapidly changing technologies.
- Regulatory uncertainty can affect responsible technology development.
- Flexible approaches are required for emerging technology management.
- Risk assessment becomes complex in uncertain technological environments.
- Continuous governance improvement supports ethical innovation.

6.2 Accountability, Transparency, and Ethical Decision-Making Challenges

Another significant challenge in technology governance is establishing clear accountability and transparency mechanisms for complex technological systems. Advanced technologies, particularly artificial intelligence and autonomous systems, may involve complicated decision-making processes that are difficult for users, regulators, and organizations to understand. Limited transparency can create challenges in determining responsibility when technological systems produce unexpected outcomes.

In addition, ethical decision-making remains a complex issue because technologies often involve competing social values and potential trade-offs. Questions related to fairness, privacy, human autonomy, and social impact require careful consideration during technology development. Governance models must establish practical mechanisms for ethical assessment, auditing, explanation, and responsibility allocation.

Accountability and ethical challenges include:

- Transparency mechanisms improve understanding of technology decisions.
- Accountability frameworks clarify responsibility for technological outcomes.
- Ethical assessments support responsible technology deployment.
- Explainability improves trust in complex systems.
- Human oversight remains important in high-impact technologies.

6.3 Global Coordination, Digital Inequality, and Sustainable Governance Challenges

Technology governance faces additional challenges due to differences in regulatory approaches, technological capabilities, and social conditions across countries and regions. Emerging technologies often operate across international boundaries, making consistent governance difficult. Differences in legal systems, ethical priorities, and technological resources can create fragmented approaches to technology management.

Moreover, sustainable technology governance must address digital inequality and ensure that technological benefits are distributed fairly across society. Unequal access to digital infrastructure, skills, and technological opportunities can increase existing social disparities. Future governance models must therefore incorporate inclusion, sustainability, and global cooperation to ensure that technological development contributes positively to diverse communities.

Global and sustainability challenges include:

- International cooperation improves consistency in technology governance.
- Digital inclusion reduces unequal access to technological benefits.
- Sustainable approaches address long-term social impacts.
- Global standards support responsible technology development.
- Inclusive governance strengthens public participation.

7. Discussion**7.1 Technology Governance as a Foundation for Ethical Innovation**

The findings of this study demonstrate that technology governance models are essential for guiding innovation toward ethical, responsible, and socially beneficial outcomes. Emerging technologies have the potential to transform industries, public services, and social systems; however, their benefits depend significantly on the governance structures established around their development and deployment. Governance frameworks provide mechanisms for evaluating risks, establishing accountability, protecting human values, and ensuring that technological progress remains aligned with societal expectations.

The discussion highlights that effective technology governance should be understood as an enabling process rather than merely a restrictive control mechanism. Well-designed governance models create conditions where innovation can progress while maintaining ethical safeguards. By integrating transparency, accountability, stakeholder participation, and continuous evaluation, governance systems can improve public confidence and support sustainable technological development.

Key discussion points include:

- Technology governance provides ethical direction for innovation processes.
- Responsible frameworks improve trust in emerging technologies.
- Governance mechanisms balance innovation with social responsibility.
- Transparency strengthens accountability of technological systems.
- Human-centred approaches support ethical technology development.

7.2 Importance of Adaptive and Participatory Governance Approaches

The analysis indicates that adaptive and participatory governance approaches are increasingly important for managing complex and rapidly evolving technologies. Traditional regulatory models may not adequately address technologies that continuously change through software updates, machine learning processes, and expanding applications. Adaptive governance enables institutions to monitor technological developments, evaluate emerging risks, and modify governance approaches when necessary.

Participatory governance further strengthens technology management by including perspectives from citizens, researchers, industry representatives, policymakers, and affected communities. Such involvement improves the legitimacy of governance decisions and helps identify social concerns that may not be visible through technical evaluation alone. Combining adaptive mechanisms with meaningful participation creates more resilient governance structures.

Important governance improvement aspects include:

- Adaptive models support continuous governance improvement.

- Stakeholder participation increases governance legitimacy.
- Monitoring mechanisms help identify emerging technology risks.
- Collaborative approaches improve decision-making quality.
- Flexible frameworks support responsible technological evolution.

7.3 Future Development of Ethical Technology Governance Frameworks

Future technology governance frameworks will require greater integration between technological innovation, ethical principles, and societal responsibility. As artificial intelligence, autonomous systems, biotechnology, and digital infrastructures continue to advance, governance approaches must become more proactive and capable of addressing complex challenges before they become widespread problems. Future frameworks should combine technical evaluation with ethical reflection and social consideration.

The discussion suggests that sustainable technology governance will depend on international cooperation, interdisciplinary expertise, and continuous institutional learning. Policymakers, technology developers, researchers, and communities must collaborate to create governance models that encourage innovation while protecting human rights, environmental sustainability, and democratic values. Future governance systems should focus on creating technologies that are not only technically advanced but also socially responsible and beneficial.

Future development priorities include:

- Proactive governance can address risks before widespread technology adoption.
- International collaboration improves global technology standards.
- Ethical frameworks guide future innovation pathways.
- Interdisciplinary cooperation strengthens governance effectiveness.
- Sustainable models ensure long-term technological benefits.

8. Conclusion

Technology governance models have become essential for ensuring that emerging technologies develop in ways that are ethically responsible, socially beneficial, and aligned with long-term human interests. This study highlights that technologies such as artificial intelligence, autonomous systems, advanced digital platforms, and data-driven innovations create significant opportunities while also introducing complex challenges related to accountability, transparency, privacy, safety, and social impact. Effective governance frameworks provide the necessary foundation for managing these challenges while supporting responsible technological progress.

The analysis demonstrates that integrated governance approaches combining responsible innovation, adaptive governance, risk-based assessment, anticipatory planning, and stakeholder participation provide stronger mechanisms for ethical technology development. These approaches help organizations and policymakers evaluate potential consequences, establish accountability structures, improve transparency, and maintain public trust. Technology governance must therefore extend beyond regulatory compliance by incorporating continuous assessment, ethical reflection, and social responsibility throughout the technology lifecycle.

The study further concludes that several challenges influence the effectiveness of technology governance, including rapid technological evolution, regulatory uncertainty, accountability limitations, digital inequality, cybersecurity concerns, and difficulties in achieving global coordination. Addressing

these challenges requires flexible governance systems, international cooperation, interdisciplinary collaboration, and continuous improvement of institutional capabilities.

In conclusion, technology governance models represent a critical pathway for achieving ethical future development in an increasingly technology-driven society. The future of innovation will depend not only on technological capability but also on the ability to guide development through responsible governance principles. Organizations and governments that adopt adaptive, transparent, and participatory governance approaches will be better positioned to ensure that emerging technologies contribute positively to society while protecting human values and public interests.

References

1. Bostrom, N. (2014). *Superintelligence: Paths, Dangers, Strategies*. Oxford University Press.
2. Collingridge, D. (1980). *The Social Control of Technology*. Frances Pinter.
3. European Commission. (2020). *White Paper on Artificial Intelligence: A European Approach to Excellence and Trust*. European Commission.
4. Floridi, L., & Cowls, J. (2019). A unified framework of five principles for AI in society. *Harvard Data Science Review*, 1(1).
5. Gasser, U., & Almeida, V. A. F. (2017). A layered model for AI governance. *IEEE Internet Computing*, 21(6), 58–62.
6. Guston, D. H. (2014). Understanding “anticipatory governance”. *Social Studies of Science*, 44(2), 218–242.
7. Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal*, 79, 1–14.
8. Kuhlmann, S., & Rip, A. (2014). The challenge of addressing Grand Challenges. In *Responsible Innovation*. Wiley.
9. Marchant, G. E., Allenby, B. R., & Herkert, J. R. (2011). *The Growing Gap Between Emerging Technologies and Legal-Ethical Oversight*. Springer.
10. Mittelstadt, B. D., Allo, P., Taddeo, M., Wachter, S., & Floridi, L. (2016). The ethics of algorithms: Mapping the debate. *Big Data & Society*, 3(2), 1–21.
11. Nielsen, M. (2015). *Reinventing Discovery: The New Era of Networked Science*. Princeton University Press.
12. OECD. (2019). *Recommendation of the Council on Artificial Intelligence*. OECD Publishing.
13. Owen, R., Stilgoe, J., Macnaghten, P., Gorman, M., Fisher, E., & Guston, D. (2013). A framework for responsible innovation. In *Responsible Innovation*. Wiley.
14. Rawls, J. (1971). *A Theory of Justice*. Harvard University Press.
15. Schot, J., & Steinmueller, W. E. (2018). Three frames for innovation policy. *Research Policy*, 47(9), 1554–1567.
16. Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, 42(9), 1568–1580.
17. Susskind, J. (2018). *Future Politics: Living Together in a World Transformed by Tech*. Oxford University Press.
18. Taddeo, M., & Floridi, L. (2018). How AI can be a force for good. *Science*, 361(6404), 751–752.
19. Wachter, S., Mittelstadt, B., & Russell, C. (2017). Counterfactual explanations without opening the black box. *Harvard Journal of Law & Technology*, 31(2), 841–887.
20. Zuboff, S. (2019). *The Age of Surveillance Capitalism*. PublicAffairs.