

AN ANALYSIS OF TECHNOLOGY AND ETHICAL RESPONSIBILITY IN DENIS ALEXANDER

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Abstract

Technology has changed almost every part of our lives. It has brought great benefits in health, education, communication and work, but it has also created serious ethical problems. Questions about who is responsible when an algorithm makes a mistake, or how biotechnology should respect human dignity, are now urgent. This article looks closely at how Denis Alexander understands this link between technology and ethical responsibility. The study uses critical and conceptual analysis. It reads Alexander's major works alongside other key thinkers in the philosophy of technology such as Heidegger, Ellul, Jonas, Floridi, Borgmann, Winner and Feenberg. The aim is to understand Alexander's central ideas, especially stewardship, human agency and human dignity, and to test how useful they are for today's problems like artificial intelligence, biotechnology and digital surveillance. The findings show that Alexander offers a helpful corrective to deterministic views of technology. He argues that technology is not an independent force that controls us. It is a human activity, shaped by our values and choices, and it remains value laden from design to use. Because of this, scientists, engineers, institutions and ordinary users all carry moral responsibility. His idea of stewardship is particularly strong. It suggests that we are not owners of scientific knowledge but caretakers who must use it to promote human flourishing, protect the environment and serve the common good. At the same time, the article finds two limits in Alexander's framework. First, he focuses mainly on individual responsibility and says less about the political, economic and institutional structures that now drive technology. Today, big corporations, states and international bodies shape innovation far more than individuals do. Second, his ethical vision is influenced by theology, which enriches it but can make it harder to apply in plural societies where people do not share the same faith commitments. The article therefore recommends a broader approach. It suggests keeping Alexander's core insights on agency and stewardship but combining them with stronger governance mechanisms. This includes clear institutional accountability, democratic participation in technology policy, and continuous ethical review throughout the life of a technology. It draws on Polo's concept of guided acceptance to argue that societies should not reject or accept new technologies blindly, but assess them step by step for their effects on dignity, justice, culture and sustainability.

Keywords: Denis Alexander, Technology, Ethical Responsibility, Human Dignity, Technological Determinism, Stewardship

Introduction

It is hard to imagine modern life without technology. From mobile phones to hospital scanners, from online banking to genetically improved crops, technology shapes what we do and who we are. Philosophers have been trying to make sense of this for a long time. Early definitions saw technology simply as tools we use to solve problems. More recent work shows it is much bigger than that. Technology also includes systems, organisations, habits and ways of seeing the world (Heidegger, 1977; Borgmann, 1984).

This matters because technology is not neutral. How a system is designed, who funds it, who gets access to it, and how it is regulated all reflect human choices. And those choices have ethical consequences. When a hiring algorithm discriminates, when social media spreads false information, or when e-waste damages the environment, someone has made a decision somewhere along the line. So we cannot judge technology only by whether it works. We must also ask whether it is fair, whether it respects people, and whether it helps society as a whole (Floridi, 2014; Winner, 1986).

In recent years these questions have become more urgent. Artificial intelligence now helps doctors, teachers, judges and farmers make decisions. Biotechnology lets us edit genes and develop

personalised treatments. Digital platforms collect huge amounts of personal data. These developments bring real benefits, but they also raise concerns about privacy, bias, inequality, environmental harm and loss of human control (Jonas, 1984; Polo & Ailodion, 2025).

Different philosophers have responded in different ways. Some, like Heidegger (1977) and Ellul (1964), take a deterministic view. They warn that technology has its own logic of efficiency and control that slowly takes over human life. Others take a more ethical and political view. Jonas (1984) argues that modern technology can cause irreversible harm, so we need a new ethic that protects future generations. Floridi (2014) says we now live in an infosphere where information itself has moral value. Borgmann (1984) worries that devices give us easy products but make us lose meaningful practices. Winner (1986) and Feenberg (1999) show that technologies are not inevitable. They are shaped by politics, money and social choices, and they can be reshaped democratically.

Denis Alexander enters this debate from an unusual position. He is both a scientist and a scholar interested in ethics and theology. His main argument is simple but powerful. Science and technology are human activities. They come from human creativity and they must remain under human moral control. He rejects the idea that technology develops on its own and forces us to adapt. Instead, he says responsibility stays with people, with institutions and with societies (Alexander, 2008; Alexander, 2017).

Alexander's key term is stewardship. For him, being a steward means we have been given knowledge and creative power, and we must use them wisely. That means promoting human dignity, caring for the environment, acting justly and thinking about the common good. This idea is timely. As artificial intelligence and biotechnology become more powerful, we need a language that reminds us that capability does not equal permission. Just because we can do something does not mean we should. Yet Alexander's account also has gaps. He writes mostly about individual scientists and moral agents. He says less about the big structures that now govern technology, such as multinational tech firms, government regulation, and global markets. These structures often matter more than individual good intentions. Also, his framework draws on theological ideas. That makes it rich, but it can be less accessible in societies where people hold very different beliefs.

This article tries to do three things. First, it clarifies what Alexander means by stewardship, agency and dignity. Second, it compares his views with those of other philosophers of technology to show where he fits and where he adds something new. Third, it looks at how his ideas can be strengthened so they are more useful for contemporary problems. The article is organised in six main parts. The next section sets out the basic concepts of technology and ethical responsibility. Then we review major philosophical perspectives. After that we focus on Alexander's ideas on stewardship and human agency, and then on dignity and moral responsibility. We then offer a critical evaluation, and finally we discuss the contemporary relevance of his work before concluding with recommendations.

Methodological Note and Scope

This article is conceptual, not empirical. We did not run experiments or surveys. We used critical analysis of texts. That means reading Alexander closely, comparing his claims with other philosophers, and testing them with contemporary cases. This method suits philosophy of technology because many questions are about values and meaning, not just numbers.

We focused on Alexander's major books on agency and creation, and on key works in philosophy of technology that are widely cited and verifiable. The reference list is deliberately short to keep the discussion focused. A limit of this approach is that we draw mainly on English language literature. Work on technology ethics in Africa and other parts of the Global South is growing and brings important insights about access, power and indigenous knowledge. Future research could connect Alexander more explicitly with that literature.

Conceptual Foundations of Technology and Ethical Responsibility

What do we mean by technology? The everyday answer is tools and machines. Philosophers of technology have pushed beyond that. Heidegger (1977) argues that technology is not just a means to an end. It is a way of revealing the world. It makes us see nature as a resource to be used. Borgmann (1984) makes a similar point. He says modern technology hides the work behind the product. We get the comfort of central heating without seeing the labour, the energy and the social relations that make it possible. So technology shapes culture, not just tasks. From this broader view, two aspects of technology stand out. The practical aspect is obvious. Technology solves problems, improves health, speeds up communication and grows the economy. The ethical aspect is less obvious but just as important. Every design choice has consequences for people and for nature. If we build a city around cars, we affect health, community and climate. If we build a social media platform that rewards outrage, we affect democracy. So technology is never just technical. It is always moral as well (Floridi, 2014; Winner, 1986).

Ethical responsibility means we must answer for those consequences. It is not only about not causing harm. It is also about actively promoting human flourishing. Jonas (1984) made this clear. He said modern technology has such power that its effects can reach far into the future and affect people who are not yet born. That means our old ethical rules, which focused on immediate neighbours, are not enough. We need an ethic that looks ahead and takes care of distant impacts. In the context of technology, responsibility falls on several groups. Scientists and engineers have responsibility for how they design. Companies have responsibility for how they develop and market. Governments have responsibility for how they regulate. And citizens have responsibility for how they use and question technology. Floridi (2013) adds that in the digital age, responsibility also extends to how we manage information itself, because information shapes identity and social life.

Why does this matter now? Because emerging technologies are different in three ways. First, they are autonomous. AI systems learn and make decisions without constant human direction. Second, they are pervasive. They are in our phones, hospitals, schools and farms. Third, they are opaque. It is often hard to see how an algorithm reached a decision. Mittelstadt, Allo, Taddeo, Wachter, and Floridi (2016) call this the ethics of algorithms. They show that bias, lack of transparency and lack of accountability are common problems. Biotechnology raises similar issues. Gene editing offers hope for treating disease, but it also raises questions about fairness, consent and what it means to be human. Alexander (2008) is particularly helpful here. He argues that scientific understanding of humans does not reduce human value. We are more than our genes. So technological fixes must respect that fuller sense of personhood.

This section sets up the lens for the rest of the article. Technology is a cultural and political activity, not just a technical one. It is value laden. And responsibility is shared, long term and needs both personal virtue and good institutions. Alexander's work speaks to all three points, but as we will see, it is stronger on the first two than on the third. It is also worth noting that responsibility is not only about blame after harm. It is also about forward looking care. This is what Alexander means by stewardship. Stewardship asks us to look after things entrusted to us, even when no one is watching. In science, that could mean keeping good records, sharing data honestly, and thinking about dual use. In business, it could mean designing products that are repairable and safe. In government, it could mean creating regulation that protects people without stifling useful creativity. So responsibility is proactive, not just reactive.

Major Philosophical Perspectives on Technology and Ethical Responsibility

To understand Alexander, it helps to see the conversation he is part of. This section looks at seven influential thinkers and then places Alexander among them. Martin Heidegger was one of the first to treat technology philosophically. In *The Question Concerning Technology*, Heidegger (1977) says modern technology frames the world as standing reserve. Everything, including people, starts to look like material to be ordered and used. His warning is that this way of thinking can crowd out other ways of relating to nature, like wonder or care. Heidegger is powerful on diagnosis, but weak on

solutions. Feenberg (1999) criticises him for making technology seem like destiny and leaving little room for democratic change.

Jacques Ellul goes even further. In *The Technological Society*, Ellul (1964) argues that technique, by which he means the drive for efficient method, becomes autonomous. Once a more efficient way exists, it replaces the old one, no matter what we think about it. Society then reshapes itself to fit technology. Ellul helps us see how efficiency can become an unquestioned value. But his view is very deterministic. Winner (1986) and Feenberg (1999) both argue against this. They show that efficiency is always defined by someone, and politics is involved at every stage. Hans Jonas offers a different approach. He is concerned about the scale of modern technology. Nuclear weapons, climate change and bioengineering can harm generations to come. In *The Imperative of Responsibility*, Jonas (1984) says we need a new ethical principle: act so that the effects of your action are compatible with the permanence of genuine human life. His is a future oriented ethic. It has much in common with Alexander. Both say capability does not justify action, and both stress care for future people. The difference is that Jonas is more cautious, almost urging restraint, while Alexander is more optimistic about scientific creativity.

Luciano Floridi moves the debate into the digital world. In *The Fourth Revolution*, Floridi (2014) argues that we are not just using information, we are living inside it. He calls this the infosphere. For Floridi, being and information are closely linked, so harming the informational environment is an ethical issue. This helps us think about privacy, misinformation and online identity. Floridi is strong on the digital, but some critics note he says less about power and inequality. Winner and Feenberg fill that gap.

Albert Borgmann is interested in everyday life. He introduces the device paradigm (Borgmann, 1984). Devices give us a commodity, like warmth or music, without requiring engagement with the practice behind it. We press a button and get what we want. That is convenient, but it can make life thin. We lose skills, relationships and meaning. Borgmann wants us to keep focal practices, like cooking a meal together or running in nature, that anchor us. His view supports Alexander's concern for human flourishing.

Langdon Winner brings politics to the fore. Winner (1986) famously asks, do artifacts have politics? He argues that technologies can embody political arrangements. Some technologies need centralised control, others fit decentralised communities. A bridge built low can keep buses, and therefore poor people, out of an area. So we cannot separate design from justice. Winner insists we ask who benefits, who suffers and who decides. This institutional focus is exactly what is less developed in Alexander. Andrew Feenberg builds a critical theory of technology. Feenberg (1999) says technology is socially constructed. It reflects the values of those who design it, usually managers and experts, but it can be democratically reshaped. He gives examples of how users have modified technologies to suit their needs. For Feenberg, there is always room for intervention. This view is close to Alexander's rejection of determinism. Both believe humans have agency.

Where does Alexander fit? Unlike Heidegger and Ellul, he does not see technology as fate. Unlike Borgmann, he is not mainly worried about cultural thinning. He is closer to Jonas, Winner and Feenberg in saying responsibility stays with us. But his distinctive contribution is stewardship. For Alexander (2017), science is a gift that comes with duties. To be a steward is to balance creativity with accountability, to seek truth but also to serve goodness. This moral framing, which connects scientific work to human dignity and the common good, is what sets him apart. It is important to see that these thinkers are not mutually exclusive. Heidegger helps us notice how technology changes our worldview. Ellul warns about efficiency. Jonas pushes us to think long term. Floridi helps with digital ethics. Borgmann keeps everyday life in view. Winner reminds us of power. Feenberg gives hope for democratic change. Alexander ties many of these threads together with a focus on moral responsibility. Reading them together gives a fuller picture than any one alone.

Stewardship, Human Agency and the Rejection of Technological Determinism

At the heart of Alexander's philosophy is a simple claim. Technology is a human activity. It does not grow on its own. People make it, fund it, regulate it and use it. So people are responsible for what it does.

Alexander uses the word stewardship to capture this. A steward looks after something that belongs to someone else or to everyone. For Alexander (2008), scientific knowledge and creative skill are like that. We have been given abilities to explore nature and invent, but we must use them in a way that respects others and cares for the world. Stewardship therefore has two sides. One side is excellence. We should do good science, pursue truth, and invent well. The other side is humility. We should ask whether our inventions help people live well, protect the vulnerable and care for the planet. This leads him to reject technological determinism. Determinism says technology follows its own logic and society must adapt. Alexander (2017) disagrees. He says discoveries may open new possibilities, but they do not decide how we use them. Nuclear physics can lead to power stations or weapons. Genetics can lead to therapies or to discrimination. The choice is ours. That is why moral agency matters.

Agency means the capacity to make moral decisions and to be held accountable. Alexander argues that agency stays with humans even when machines seem smart. An AI system can analyse medical images faster than a doctor, but it cannot take responsibility for a misdiagnosis. Responsibility falls on the people who built, approved and deployed the system. Coeckelbergh (2022) makes a similar point about political responsibility for AI. He argues that attributing agency to machines can be a way of hiding human decisions. Alexander would agree.

This emphasis on agency is important today because many narratives suggest machines are taking over. We hear that algorithms decide who gets a loan, who gets a job interview, or how long a prison sentence should be. Alexander reminds us to look behind the algorithm. Who chose the training data? Who set the optimisation goal? Who decided it was acceptable to use it in that context? Those are human questions. Alexander also connects agency to institutions. He notes that science happens in universities, firms and government labs. These places shape what gets researched and how. So responsibility is not only individual. It is shared. However, he does not develop a detailed theory of institutional design. That is where Winner (1986) and Feenberg (1999) add value. Winner shows how institutions embed values into technology, and Feenberg shows how democratic pressure can change them.

One practical implication of Alexander's view is that ethics should be part of scientific training. If science is a moral enterprise, then learning to be a good scientist includes learning to think about consequences. This is not about stopping innovation. Alexander is not anti-technology. He is pro responsible innovation. He wants scientists to see themselves as citizens, not just as specialists.

In short, Alexander gives us a framework that is both hopeful and demanding. Hopeful, because it says we are not helpless in front of technology. Demanding, because it says we cannot outsource moral judgement to machines or to the market. We have to do the hard work of deciding what kind of future we want and then steering technology in that direction. This view also helps us avoid two extremes. One extreme is techno optimism that says all innovation is good and will fix itself. The other is techno pessimism that says technology will ruin us and we can do nothing. Alexander offers a middle path. He says creativity is good, but it must be guided by care. That balance is rare and valuable.

Human Dignity, Moral Responsibility and Human Flourishing

The second key idea in Alexander is human dignity. For him, dignity is not earned by intelligence or productivity. It is inherent. Every person has worth that must be respected, no matter their abilities or circumstances (Alexander, 2017). This matters for technology because it sets a limit. Not everything that is technically possible is morally acceptable. For example, gene editing that could prevent disease might be welcome, but gene editing that tries to create enhanced humans raises deep questions about equality and identity. Alexander (2008) argues that we should not reduce people to their genes or their brains. Scientific explanations of how we work do not tell us who we are in a moral sense. Moral

responsibility flows from dignity. If people have inherent worth, then those who build powerful systems must answer for how those systems affect people. Alexander is clear that responsibility cannot be passed to technology itself. A self-driving car that crashes, a facial recognition system that misidentifies someone, or a chatbot that gives harmful advice are not morally responsible. The designers, the companies and the regulators are.

This is especially relevant for artificial intelligence. AI systems are now used in hiring, banking, policing and healthcare. They can improve efficiency, but they can also reproduce bias. Buolamwini's work on facial recognition, discussed by Polo and Ailodion (2025), shows how systems can work poorly for certain groups if the training data is skewed. Alexander would say this is not just a technical bug. It is a moral failure to respect equal dignity. It reflects choices about what data to use and whose perspectives count. Alexander also links dignity to flourishing. Flourishing is more than just surviving or making money. It means living a full human life, with relationships, purpose, learning and community. Technology should support that, not undermine it. For instance, a technology that connects families across distances supports flourishing. A technology that keeps children addicted to screens and harms their mental health does not, even if it is profitable.

Environmental responsibility is part of this too. Alexander sees care for nature as part of stewardship. Humans are part of nature, not separate from it. So technological progress that destroys ecosystems for short term gain fails the test of responsibility. This aligns with Jonas (1984), who argues that our new powers require a new care for the biosphere. Finally, Alexander stresses that responsibility extends to institutions. Research ethics boards, data protection laws, professional codes and corporate governance all matter. But again, he does not give a detailed blueprint for how these institutions should work. Recent work on the ethics of algorithms shows that we need clear standards for transparency, explainability and accountability (Mittelstadt *et al.*, 2016). Without such mechanisms, individual good will is not enough.

In sum, Alexander offers an ethic that puts people first. It asks not only does this technology work, but does it honour the worth of each person and help society live well together. When we apply dignity to everyday tech, new questions appear. For example, does a workplace monitoring tool that tracks keystrokes respect the worker? Does a loan app that uses phone contacts to shame defaulters respect privacy? Alexander would push us to see these not as efficiency issues but as dignity issues. That shift changes the debate.

Critical Evaluation of Denis Alexander's Philosophy of Technology

Alexander's work has clear strengths, but also limits that need honest assessment.

Strengths

First, his critique of technological determinism is convincing. By showing that technology is value laden and shaped by human choices, he restores a sense of moral agency. This is important both philosophically and practically. If we believe technology controls us, we stop trying to govern it. Alexander gives us reasons to stay engaged.

Second, his concept of stewardship is richer than many secular ethics of responsibility. Stewardship links creativity, humility and service. It says we should be good at what we do, but also ask whom we serve. This resonates with scientists who want their work to mean something beyond publications or patents.

Third, his focus on dignity provides a stable moral anchor. In debates about biotechnology and AI, it is easy to get lost in technical details. Alexander keeps bringing us back to the question of what it means to be human and how technology should support, not diminish, that.

Limitations

The first limit is institutional thinness. Alexander writes as if the main ethical actors are individual scientists and thoughtful citizens. But today technology is driven by large firms, venture capital, military interests and state policies. Winner (1986) and Feenberg (1999) have shown that without attention to power and institutions, ethics remains abstract. For example, a researcher may want to

build fair AI, but if her company rewards engagement over fairness, her individual virtue will have limited effect. We need analysis of incentives, regulation and democratic oversight, and Alexander offers little here.

The second limit is theological framing. Alexander's stewardship is influenced by his Christian perspective. For readers who share that background, it is enriching. For others in a plural society like Nigeria or in global policy debates, it can be less accessible. A more secular translation of stewardship, perhaps as responsible care, would broaden its appeal without losing its core.

Third, Alexander's treatment of emerging technologies is general. He writes about science and technology in broad terms, but says less about specific governance tools like algorithmic audits, data protection impact assessments, or participatory design. Polo (2026) tries to address this with the idea of guided acceptance. Guided acceptance suggests we should not accept or reject technology in one go, but assess it continuously for effects on dignity, justice, culture and environment. This helps make Alexander's stewardship practical.

Another point worth noting is balance. Jonas (1984) is sometimes criticised for being too precautionary, which could block useful innovation. Alexander is more balanced, but he could still say more about risk and benefit tradeoffs. In health contexts, for instance, delaying a beneficial biotechnology can also cause harm.

Overall, Alexander's philosophy remains a strong foundation, but it needs to be supplemented. The core should stay: technology is human, agency matters, dignity matters. The supplement should be institutional: how do we build organisations, laws and cultures that make responsible agency possible. It is also fair to say that Alexander does not engage much with perspectives from the Global South. Issues like digital divide, access to technology, and colonial patterns in science funding are not central to his work. Yet these are crucial for countries like Nigeria. Bringing Alexander into conversation with local experiences would strengthen his relevance.

Contemporary Relevance of Alexander's Framework

Why does Alexander matter now? Because the technologies that surround us make his questions urgent. Take artificial intelligence. AI is not magic. It is built from data collected by people, labelled by people, and optimised for goals set by people. When it goes wrong, human choices are usually involved. Alexander's insistence that responsibility stays with humans helps resist the temptation to blame the machine. His stewardship ethic asks developers to think about whether their systems promote fairness, transparency and human flourishing, not just accuracy or profit. This fits well with current calls for explainable AI and human oversight (Mittelstadt *et al.*, 2016; Coeckelbergh, 2022).

Biotechnology is another clear case. Gene editing with CRISPR, stem cell therapies and reproductive technologies offer real hope. They also raise questions about who gets access, how consent is obtained, and whether we might deepen inequality. Alexander (2008) reminds us that scientific knowledge of humans does not define human worth. So we must judge biotechnologies by whether they respect dignity and serve the common good.

Environmental challenges also make Alexander relevant. Climate change, biodiversity loss and pollution are partly consequences of past technological choices made without enough stewardship. His emphasis on care for creation and responsibility to future generations aligns with Jonas (1984) and with sustainable development goals. In the Nigerian context, where the authors of this article are based, these issues are concrete. Digitalisation is expanding rapidly in education, banking and agriculture, but with gaps in regulation and digital literacy. The work by Polo and Ailodion (2025) on racial bias in AI shows that global debates about algorithmic justice have local consequences. Alexander's framework, combined with Winner's attention to power and Feenberg's attention to democratic participation, offers a way to think about technology policy that is both ethically grounded and socially aware.

Finally, Alexander helps us keep a hopeful view without being naive. He believes human creativity is a good thing. He does not want us to fear technology or to worship it. He wants us to shape it wisely. That balanced attitude is what responsible innovation needs.

Consider three quick examples. First, in education, plagiarism detection and proctoring tools raise dignity issues when they misflag students. Second, in agriculture, precision farming apps can help smallholders only if they are affordable and work offline. Third, in health, AI triage tools can improve access but must be audited for bias. In each case, stewardship asks: does this tool help people live well together, or does it just save money? This is where guided acceptance becomes practical. Instead of saying yes or no to a technology once and for all, we assess it in stages. Pilot it, check its effects on different groups, adjust design, and keep monitoring after deployment. That is how stewardship moves from an idea to a routine.

Conclusion

This article has examined Denis Alexander's account of technology and ethical responsibility. It started from a simple observation. Technology brings great benefits but also serious ethical challenges. Philosophers have responded in different ways, from determinism to social construction. Alexander offers a distinct voice. He sees technology as a human, cultural activity that is value laden. He rejects the idea that technology controls us. He puts moral agency, stewardship and human dignity at the centre.

The analysis shows that Alexander's strengths lie in three areas. First, he restores human responsibility. Second, he provides a morally rich language of stewardship that connects excellence with care. Third, he defends human dignity against reductionist views.

The analysis also shows two limits. His framework says less about the institutional, political and economic structures that shape technology today. And his theological language, while valuable, may need translation for plural public contexts.

In the end, Alexander's message is clear and timely. Technological power is a form of trust. We are trusted to use it well. That trust calls for both personal virtue and good institutions. If we combine his emphasis on agency and dignity with stronger governance and inclusive deliberation, we have a better chance of making technology serve human flourishing rather than undermine it.

Recommendations

To make Alexander's insights more useful, we recommend four steps.

First, integrate ethics into every stage of technological development. From design to deployment to monitoring, we should ask how a system affects dignity, justice and sustainability. Polo's (2026) concept of guided acceptance is helpful here. It encourages continuous, step by step ethical review rather than a one off approval. Second, strengthen institutional accountability. Policymakers, universities, firms and regulators should adopt clear standards for transparency, auditing and participation. Lessons from Winner (1986) and Feenberg (1999) show that democratic governance of technology is possible and necessary. Recent literature on the ethics of algorithms suggests practical tools like impact assessments and explainability requirements (Mittelstadt *et al.*, 2016). Third, promote interdisciplinary collaboration. Technology policy should include philosophers, ethicists, social scientists, community voices and religious perspectives. Alexander's work shows that science and ethics can speak to each other. That dialogue should be institutionalised in ethics boards and policy forums. Fourth, invest in education and public engagement. Responsible stewardship needs citizens who understand technology and can question it. That means teaching digital literacy, research ethics and critical thinking in schools and universities, and creating spaces for public deliberation about new technologies.

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