



Envisioning Tomorrow: How Philosophy of Science Shapes Sustainable Sci-Tech Policies

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Abstract: Progress in various fields is developing rapidly, especially in science and technology which has brought significant changes in various aspects of human life, ranging from communication, education, to the economy. This research uses a normative juridical method with library studies as the main data source and core data as a complement. The approaches used include a statutory approach and a conceptual approach. The study findings include analytical, descriptive, and prescriptive information, with prescriptive analysis offering ideal legal solutions and descriptive analysis describing events or facts in detail and systematically. The results show that Philosophy of Science plays a central role in shaping sustainable science and technology policy. Through critical reflection on the complex relationship between science and technology as an inseparable part of culture, philosophy of science promotes responsible use and considers social and environmental impacts. Contributions such as the development of local epistemologies, critical thinking on western knowledge, and the development of locally relevant concepts demonstrate the important relevance of philosophy of science in Indonesia. It also facilitates harmonious dialogue between science, religion, and culture, and encourages critical thinking about technology and innovation. The philosophy of science's thoughtful and sustainable approach is key in steering technological development towards positive impacts for people and the environment in this increasingly complex era.

Keywords: Philosophy of Science, Science and Technology, Sustainable Policies.

Received: 10 May 2024 **Revised:** 10 June 2024 **Accepted:** 29 June 2024

1. Introduction

Advances in various fields have developed massively since entering the 21st century. Especially in the last 10 years, technological developments are not only felt in the industrial world, but increasingly have a significant impact on daily life for all mankind (Alhudawi et al., 2023). The rapid development of information technology has brought significant changes in various aspects of human life, from communication, education, to the economy. Behind this progress, there are major challenges that must be faced, such as privacy issues, data security, and the environmental impact of the production and disposal of technological devices.

In this context, philosophy of science plays an important role in providing a theoretical foundation and ethical framework to address such issues and shape sustainable information technology policy. Philosophy of science, which focuses on critically analyzing the foundations of scientific knowledge and methodology, offers deep insights into how science should be developed and applied. By understanding the nature of knowledge, the validity of the scientific method, and the ethical implications of technological applications, policymakers can formulate strategies that are not only innovative, but also socially and environmentally responsible (Anggreini et al., 2023).

Basically, science is a human effort to describe various empirical phenomena that occur in nature. The main purpose of this effort is to gain a proper understanding of these phenomena. Since the rediscovery of

rational human thought, there has been a strong belief that science is the only source of truth (Safarudin et al., 2022). All explanations that cannot be tested, scrutinized or observed are considered untrue and therefore unreliable. This issue is further complicated by the concept of interconnectedness, which highlights the interconnectedness of disciplines. Rapid developments in various disciplines have created a need for integration between fields, which requires deep understanding and interdisciplinary skills (Nurhasnah et al., 2023).

Cultural development in recent centuries has been rapid, fueled by population growth and rapid advances in science and technology (Setio et al., 2024). The presence of technology is not only limited to technical innovations, but also includes advances in science. Over time, humans have continued to develop knowledge and technology. However, the rhythm of this development often leads humans to overlook the negative side of science and technology, being too enamored by the various conveniences it offers (Retnosari, 2020). For example, epistemological approaches in philosophy of science can help identify and manage the uncertainties and risks associated with new technologies. Meanwhile, ethical reflection can guide in setting moral and legal boundaries regarding the use of personal data, which is becoming increasingly important in this digital age. In addition, philosophy of science can also promote transparency and accountability in decision-making processes, ensuring that the development of information technology remains in line with the principles of justice and sustainability.

The rapid development of information technology encourages the country to create the next generation of quality. Therefore, the utilization of technology in education and training must be done creatively and wisely. Humans, as the main actors in the development of science and technology, need to realize the importance of philosophy to provide realistic and logical limits in developing science so as not to harm humans, nature and the environment. With the advancement of science and technology accompanied by a scientific worldview and way of thinking, science and technology can have a positive impact on human life. In addition, this change requires the development of potential and understanding of a critical mindset to face the times in order to stay on the right track (Handraini & Fitrisia, 2023).

In this research, it will be discussed how philosophy of science can concretely contribute to the formation of sustainable science and technology policies. Through interdisciplinary analysis, this research aims to show that the integration of philosophy of science in the policy process not only enriches our understanding of technology, but also strengthens our efforts to build a more just and sustainable future.

2. Methodology

The research method used is normative juridical, and takes the form of a data study conducted by examining library studies (*librarian study*) (Soemitro, 1994). While the core research data only serves as complementary data. This study uses various methodologies, including a *statute approach*, namely reviewing all laws and regulations related to the legal issues being investigated (Marzuki, 2010). In addition, it also uses a *Conceptual Approach*, namely by combining practical concepts that can be implemented into a particular point of view and become a solution to the problems that have occurred (Ibrahim, 2007).

Study findings include analytical, descriptive, and prescriptive information. Prescriptive is a solution to the legal problems raised and etymologically means what should be (Marune, 2023), while analytical descriptive research is limited to efforts to reveal a problem and situation as it is (Marune, 2022), so that it only reveals or describes an event or fact that exists in detail, systematically, and thoroughly (Kurnia et al., 2013).

3. Discussion

Relationship between Philosophy and Science

The reality of human activity is reflected in the relationship between philosophy and science, both of which are the result of conscious human thought. In the process, this activity is shown through efforts to solve problems of human life in order to obtain truthful knowledge based on certain methods or procedures that

are critical and systematic. Philosophy and science have a complementary relationship and form an inseparable unity. Instead of being opposed, they complement and enrich each other. Therefore, it is important to compare philosophy and science to understand the differences and common ground between them.

All sciences, whether exact or social and analytical, were originally born from philosophy. However, over time, these sciences separated themselves from philosophy according to their respective formal objects (Varpio & MacLeod, 2020). Learning philosophy in the context of science and knowledge emphasizes a synoptic approach, because the nature of philosophy itself is not contained in its separate parts. Descriptively, science serves to explain its object in order to discover various facts and techniques, including the tools used (Zaprul Khan, 2016). In contrast, philosophy never describes anything concretely, but rather assists humans in making decisions about the purpose and value of what they do. Therefore, philosophy is not neutral because it is still very subjective. This subjectivity factor is very important and plays a big role in philosophizing, which then becomes the foundation for science to start its assumptions.

In its investigation and contemplation to formulate assumptions, philosophy uses the method of controlled experimentation to verify theories by testing them through the practice of sensing. Therefore, philosophy must rely on reason and human experience to examine problems that cannot be solved by other sciences or knowledge (Bigaj & Wüthrich, 2016). The concept of evolution encourages individuals to revisit ideas and interpretations in science, criticize scientific assumptions and postulates, and conduct critical analysis in all fields of terminology. This approach ensures that philosophy does not rely solely on logic but also integrates real-life experiences, so as to provide comprehensive solutions to complex problems (Juhaya, 2003).

The emergence of science was first based on philosophy. Philosophy is often referred to as the mother of all sciences because philosophy is not limited by anything, while science has certain limitations. The connection between science and philosophy arises from a reflective attitude and curiosity, driven by the love of truth in human activity. Philosophy easily integrates with the various sciences needed, and through its methods, philosophy is able to question the assumptions, truth, and validity of science itself. While science cannot always question its own assumptions and methods of validity, philosophy has the capacity to reflect deeply on these matters.

Reflection on ideas and interpretations, whether in science or the field, shows that philosophy acts as a meta-science, where science is the concretization of parts of philosophy. The phenomena faced by humans must be analyzed critically, reflectively, and integrally, as well as with a logical and universal approach. As a science that has distinctive methods and objects, philosophy is able to systematically formulate the achievement of predetermined goals. This makes philosophy a discipline that not only investigates the basic assumptions behind science but also provides a framework for the development and integration of various fields of science.

All science has its roots in philosophy. Historically, science developed from the foundations of philosophy, which means that before science existed, philosophy already had a strong foundation. Philosophy provided the initial framework and methods that allowed the various branches of science to emerge. However, over time, science began to separate itself from philosophy and sought to stand on its own as an independent discipline, no longer directly tied to philosophy.

The position and relationship between philosophy and science can be summarized as follows (Suriasumantri, 2007):

1. Purpose of Philosophy

The main goal of philosophy is to understand the nature of the object in its study. This understanding must be defended and accounted for rationally (logically) and factually so that it can be directly experienced in human life. Philosophy not only seeks knowledge, but also understands the reasons and basic principles underlying that knowledge.

2. Axiology

The main subject of philosophy is the question of the value (axiology) of an object. Philosophy maintains the importance of value, which means that issues such as cloning and euthanasia must be evaluated based on their moral impact. Philosophy plays a role in criticizing and evaluating the moral and ethical aspects of scientific and technological developments.

3. Methodological Critique

Philosophy also functions as a critic of scientific methodology. In this regard, social science is often the subject of sharp criticism from philosophy, which gives rise to new paradigms other than positivistic views, such as critical and humanistic approaches. Philosophy encourages science to consider a more holistic and humanistic approach in its research and application.

Thus, although science has developed into an independent discipline, the relationship between philosophy and science remains important. Philosophy provides a theoretical and reflective foundation, while science provides empirical data and concrete findings. Both complement each other in human efforts to understand and explain the world, and ensure that the development of science always considers rational, factual, ethical, and humanistic aspects.

Contribution of Philosophy of Science in the Formation of Sustainable Science and Technology Policy

The growth of science and technology today is very rapid and has a significant impact on the lives of every individual. Today, almost every aspect and stage of human life is affected by advances in science and technological development. These two fields are not simple entities; they are closely related to the fundamental drives and creative instincts that exist within human beings. The relationship between science and technology is very close, intertwined, and mutually influencing (Gie, 1996).

The 21st century shows that the current era states a postmodern society that is heterogeneous in nature to store many complex problems with before. To overcome these various problems, science and technology as the foundation of the presence of positivism transformation in modern society must be studied more deeply both in terms of holistic comprehensively (Tasnur & Sudrajat, 2020). The movement of globalization causes the rapid increase in the influence of social order and structure which triggers disruptive problems when the rise of the internet always affects life (Savitri, 2019).

Friedman, Ritzer including Toffler by mentioning the new era disrupts various aspects of human life. Human existence will care about the swift sophistication of technology due to globalization in the Industrial Revolution 4.0 so that it has an impact and plays a role on humans as degradation. The emergence of robots due to human artificial intelligence will lead to *Society* 5.0 will make dehumanization to eliminate the role of humans in the world of work and industry which is replaced by rapid changes in science and technology in the Industrial Revolution 4.0 (Ibda, 2019).

Humans who philosophize mention the sublimation of scientific disciplines as their responsibility in the search for new theories or paradigms for the benefit of all humans (Rofiq, 2018), thus making self-reflection of philosophy a scientific forum in achieving truth and reality (Nasution, 2016). New innovations will emerge due to the development of science and technology and will influence each other including their positive and negative impacts, for this reason philosophy is present as a foundation in the development of science and technology whose application can be accounted for by every human being to the Creator of science with technology ethically for the common good.

The implications of the application of science and technology are controlled on the basis of philosophy by seeking reflection to test and criticize the assumptions as well as the scientific methods used in answering all the challenges that will arise in the era of digital disruption (Habibah, 2017). The beginning of the development of philosophy is seen from the planning of every human being to overcome problems such as nature, humans and God so that philosophy as a bridge to the formation of human civilization which will play a role in the realization of relationships including the relevance of philosophy and science in the

disruption of society which will enter a revolution in the industrial series 4.0 including society series 5.0 due to the transformation of technological expansion in every aspect of human life which will answer all the problems that will occur (Latif, 2014).

Thinking critically as well as independently is a method of philosophical concepts so that it can be adjusted to the entry of challenges from the changing times that exist today with personal creativity that is critical as well as open to new opportunities in order to make an important contribution to life. This is supported by Jürgen Habermas who mentions science with human interests through technical and practical including emancipatory for the formation of a prosperous community lifestyle. Its application is in creating a society that is critical of the current situation in exploring the concept of philosophizing as a manifestation of changes in the progress of people's lifestyles (Semiawan, 2006).

The existence of social media allows some people to speak arbitrarily so that it is easy to spread and not necessarily correct information, which easily triggers tension conflicts. Therefore, the government issued the ITE Law so that the ethics of speaking in general and for the good of everyone is revived so that it can be directed to balance and control it so that harmonious social life in digital communication networks. An expert opinion named Rudy Harjanto & Lasiyo said learning to the philosophy of life from the Taoist point of view, namely Te Ching Lao Tsu which is called the door to goodness for three main focuses, namely love, simplicity and humility.

The three focuses must be carried out simultaneously for every human being in responding to the changing times and must be like water which means the provision of benefits in the support of human life accompanied by acts of gentleness without resistance (Lasiyo & Harjanto, 2018). The rapid pace of the digital era in the age of globalization requires us to understand a philosophy that is very relevant, namely the philosophy of Tao Te Ching in facing the challenges of globalization, especially the digital era by acting wisely or wisely in making a decision and always humbly willing to learn all the changes that occur so as to be able to adjust to these changes that inevitably occur and are experienced by every human being when living this wheel of life.

This opinion is supported by the theory of epistemology because the branch of philosophy related to the theory of knowledge which means that knowledge is not only known as rational thought but also uses scientific methods to see the correlation and relevance of philosophy with science to the industrial revolution series 4.0 and society series 5.0 the development of accelerated technology and innovation and is supported by the research of Nurhayati and Ahmad Syukuri and Badarussyamsi who mention the role of philosophy of science for the advancement of scientific development (Nurhayati et al., 2021) and also supported by Nafiur Rofiq's research that the role of philosophy of science for the development of science makes the measure of scientific truth at a positivistic level so that philosophy of science can stand in the middle of the branch of science as a controller and director for its application (Budiarmaja et al., 2024).

If we examine more deeply from various aspects and nuances, there are several points of intersection between science and technology, namely:

1. Components of Culture

Both science and technology are integral components of human culture. They reflect the achievements, values and aspirations of the societies in which they develop. Science provides a deep understanding of nature and the phenomena around us, while technology applies that knowledge to create tools and systems that improve the quality of human life.

2. Ideational and Factual Dimensions

Science and technology have both ideational and factual aspects. In science, ideational aspects include theories and concepts that explain various phenomena, while factual aspects consist of empirical data and findings. Similarly, technology contains ideational dimensions in the form of design and innovation, as well as factual dimensions realized in real products and applications.

3. Abstract and Concrete Dimensions

They also have abstract and concrete dimensions. The abstract aspects of science include the principles and laws that underlie our understanding of the world, while the concrete aspects involve experiments and observations that support or refute the theory. In technology, the abstract dimension includes planning and conceptualization, while the concrete dimension involves making and using tangible tools and systems.

4. Theoretical and Practical Dimensions

Science and technology have complementary theoretical and practical aspects. The theoretical aspects of science are concerned with the development of theories and models that explain natural phenomena, while the practical aspects involve the application of this knowledge in areas such as medicine, engineering and the environment. In technology, the theoretical aspect includes the principles of design and innovation, while the practical aspect involves the implementation and operationalization of such technologies in everyday life.

Thus, science and technology cannot be separated from each other. They complement each other and together drive human progress. Science provides the necessary theoretical basis for technological development, while technology enables the practical application of scientific knowledge, which in turn expands the horizons of scientific research. This interconnectedness ensures that progress in one field will trigger development in the other, creating a continuous cycle of innovation and improvement in the quality of life.

There is a dialectical relationship between science and technology. On the one hand, science provides theories that become important supporting materials for technological advancement. On the other hand, technological discoveries greatly help expand the horizons of scientific research through the development of cutting-edge technological research tools. In fact, it can be said that today the advancement of science depends heavily on the support of technology, and vice versa, the advancement of technology depends heavily on the support of science (Surajiyo, 2008).

Philosophy of science is needed in the midst of the development of science and technology, which is marked by the sharpening of scientific specialization. Because by studying the philosophy of science, scientists will realize their limitations and not be trapped into an attitude of intellectual arrogance. What is more needed is an attitude of openness among scientists, so that they can greet each other and direct all their scientific potential for the benefit of mankind (Muntansyir & Munir, 2006).

Philosophy of science as a special branch of philosophy that talks about the history of the development of science. Scientific methods, ethical attitudes that scientists must develop in general contain the following objectives: First, philosophy of science as a means of testing scientific reasoning, so that people become critical of scientific activities. A scientist must have a critical attitude towards his own field of science, so as to avoid a solipsistic attitude, thinking that only his opinion is the most correct.

Second, philosophy of science is an effort to reflect, test, and criticize scientific assumptions and methods. The tendency among modern scientists is to apply a scientific method without regard to the structure of science itself. One attitude that is needed here is to apply scientific methods that are appropriate or suitable for the structure of science, not the other way around. Method is only a means of thinking, not the essence of science.

Third, the philosophy of science provides a logical basis for scientific methods. Every scientific method developed must be logically-rationally justified, so that it can be understood and used in general. The wider the acceptance and use of scientific methods, the more valid the method is, the discussion in this case is discussed in methodology, which is the study of ways to obtain truth (Azfirmawarman et al., 2023). Therefore, philosophy eventually gives birth to several implications that can be obtained from studying and understanding the role of philosophy in science and technology. For a scientist, adequate basic knowledge about science, both natural and social sciences, is needed so that scientists have a strong foundation.

Indonesian Philosophy of Science has made significant contributions to the development of science in the

country. In this chapter, we will explore some of the key contributions that Indonesian Philosophy of Science has made (Fahrurrozhia & Kurniab, 2022).

1. Development of Local Epistemology

Philosophy of Science in Indonesia has played an important role in developing a local epistemology that values traditional wisdom, culture, and philosophy in the creation of knowledge. By considering the Indonesian cultural context, Philosophy of Science can produce a unique approach to science development that takes into account local values. This is important for maintaining the sustainability of traditional knowledge and enabling the development of science that fits Indonesia's social and cultural realities.

2. Critical Thinking on Western Knowledge

Philosophy of Science in Indonesia also makes a significant contribution in criticizing Western knowledge introduced in Indonesia. By questioning the basic assumptions and methods of Western knowledge, Philosophy of Science helps analyze the social, cultural and political impacts of such knowledge. This allows for a more inclusive and critical perspective on global knowledge, and enriches intellectual debates in Indonesia.

3. Development of Local Concepts

Philosophy of Science in Indonesia has helped develop unique local concepts in various fields of science. Through a deep understanding of local wisdom, Philosophy of Science contributes to producing concepts that are more relevant and useful to Indonesian society. Examples are concepts in the social sciences such as gotong royong, adat istiadat, and other local wisdom that enrich our understanding of Indonesian society and culture.

4. Critical Thinking on the Social and Environmental Implications of Science

Philosophy of Science in Indonesia has promoted critical thinking about the social and environmental impacts of scientific development. In the face of an increasingly complex and challenging era, Philosophy of Science invites deep reflection on the responsible use of science for the benefit of society and the environment. By questioning the impact of scientific progress on social equality, environmental sustainability and justice, Indonesian Philosophy of Science seeks to ensure that scientific development does not only pursue technical progress but also takes into account the well-being of people and nature.

5. Dialogue between Science and Religion/Culture

Philosophy of Science in Indonesia also encourages dialog and harmonious interaction between science and religion and culture. In the context of a society rich in religious and cultural diversity, Philosophy of Science plays an important role in addressing potential conflicts and seeking ways to integrate diverse perspectives. This approach creates an environment conducive to collaborative research and the construction of a more holistic science, where different views can complement and enrich each other.

6. Critical Development of Technology and Innovation

Philosophy of Science in Indonesia also plays a role in developing critical thinking about technology and innovation. In the midst of rapid technological advances, Philosophy of Science encourages society to question the ethical and moral aspects of technology use, including its implications for privacy, human rights, and social justice (Nabila et al., 2023). As such, Philosophy of Science assists society and policymakers in making thoughtful and ethical decisions when facing the challenges of modern technology, ensuring that technological innovation brings not only progress but also fair and equitable prosperity.

The Impact of Philosophy on the Progress of Human Civilization in the Field of Technology

Technology is the result of human creation to manage the environment and adapt to it. Technology also serves as a tool for humans to meet basic needs such as food, mobility, communication, and defense, and to improve their quality of life. Mastery of technology is very important (Besari, 2008). Humans and the environment have a reciprocal relationship, where the environment affects humans, so technology also has

an impact on humans.

Simple early technologies, such as wood, stone and bone technology, were few in number and slow in growth, so their impact on humans was not immediately apparent. In contrast, advanced technologies that develop rapidly and on a large scale have a broad and profound impact on people. These effects can be direct or primary, and they can also be less immediately visible, such as secondary or tertiary effects. Jacob identified seven negative impacts of technology on humans which can be explained as follows (Jacob, 1988):

a. Human *Displacement* or Replacement (*Displacement, Substitution*)

For example, the functions of large human muscles in work are replaced by technology, leading to atrophy in humans. Entire human functions can be replaced by robots, resulting in humans being marginalized from their jobs. This illustrates how technology can replace human roles, causing unemployment and changes in social structure.

b. Restrained Freedom

While technological developments increase the number of choices available, people often find that their options are increasingly limited. Technology makes many things possible, but few human desires can be fulfilled. In many aspects, people have to adapt to existing tools and systems, reducing individual freedom and flexibility in making personal choices.

c. Squeezed Personality

People tend to be part of a uniform mass, with less and less privacy. They become a small part of central planning and are required to participate in the system. Individual personalities are squeezed by the need to conform to norms dictated by technology and society at large, reducing personal individuality and exclusivity.

d. Human Objectivization (Dehumanization)

Humans are treated as objects that can be decomposed into components that can be measured or calculated. Other aspects that cannot be measured are considered peripheral and receive no attention in human development, education and enhancement. Technology evolves into complex, expensive and increasingly autonomous systems, which are difficult for humans to control. As a result, humans often become mere efficient components or even slaves of the technological systems they themselves create.

e. Technological Mentality

This mentality is reflected in an excessive trust in tools and technology (*technocentrism*), where people tend to believe that all problems can be solved with technology. There is an assumption that something will be more valid and convincing if it is done with sophisticated equipment and supported by numerical data. This results in an over-reliance on technology and ignores non-technological solutions that may be more suitable.

f. Non-adaptive rebalancing

To restore the balance disrupted by technology, people often take unhealthy shortcuts, such as the use of drugs to aid adaptation, including narcotics and psychedelics. In addition, they also tend to seek power and recognition through the accumulation of luxury or *positional goods* to compensate for their inability to adapt to the changes caused by technology.

g. Technological Crisis

The crises that have hit the world in this century are largely due to the rapid development of technology, which does not allow enough time for individuals and societies to adapt and integrate the changes. The result of the inability to adequately adapt and integrate is the emergence of problems such as technostress, urban disease, and other diseases of civilization. Systems under stress will show signs of pathology. In addition, destructive technologies are also rapidly developing, such as the nuclear arms race, which makes

traditional warfare irrelevant as a means of conflict resolution.

There are several impacts of technology on the community environment, including (Habibah, 2017):

- a. Resource depletion As technology tends to develop towards the creation of new needs, hyperconsumption, the exploitation of resources increases, especially to satisfy cultural needs.
- b. Climate disruption The growth of megalopolises and industrial areas can cause weather changes.
- c. Environmental pollution.
- d. Environmental destabilization and decompensation In the last stages, decompensation will occur, when nature can no longer maintain the necessary balance due to the continuous impact of technology.
- e. Information overload The imbalance of information between different layers of society and between communities will create tensions.
- f. If socio-economic dynamics do not move in tandem with increased consumption, then Third World societies will only become consumers of luxury goods that are incompatible with their stage of progress.
- g. Destruction and extinction of animal and plant species
- h. Biocultural distortion

This situation is actually taking place now. The symptoms of personal disequilibrium in various pathological forms, such as social drug addiction, gambling, crime, violence, economic hardship, *venality of public officials*, intellectual unrest, rape, divorce, the arms race and others have become institutionalized. This is mainly due to the highly accelerated progress of post-industrial societies in the First World. On the other hand, attempts at revitalization and renaissance are visible here and there.

4. Conclusions

Based on the results of the above research, the author concludes that Philosophy of Science has an important role in shaping sustainable science and technology policies. By recognizing the close relationship between science and technology as part of culture that has abstract and concrete dimensions, philosophy of science encourages critical reflection on the use and impact of both. The development of local epistemologies, critical thinking about Western knowledge, and the development of local concepts relevant to Indonesian culture are some important contributions. In addition, philosophy of science also highlights the importance of considering the social and environmental implications of scientific progress, facilitating dialogue between science and religion and culture, and encouraging critical thinking about technology and innovation. This approach ensures that the development of science and technology pursues not only technical progress but also human and environmental well-being, and enriches intellectual debates in Indonesia.

Philosophy plays an important role in technological advancements aimed at managing the environment and meeting basic human needs. The reciprocal relationship between humans and the environment shows that technological development has a significant impact on human life. Early technologies had a limited influence, while advanced technologies have a broad and profound impact. Jacob identified seven negative impacts of technology on humans: replacement of humans by machines, limitation of freedom, suppression of personality, dehumanization, over-technological mentality, non-adaptive rebalancing, and technological crisis. In addition, technology impacts the environment through resource exploitation, climate disruption, pollution, destabilization, information overload, unbalanced mass consumption, and species extinction. Therefore, a thoughtful and sustainable approach is indispensable in technology development.

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