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Review

The Role of Technology in the Digital Economy's Sustainable Development of Hainan Free Trade Port and Genetic Testing: Cloud Computing and Digital Law

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Abstract: In an era of swift technical advancement, the confluence of digital technology, security, and the digital economy bears substantial implications. This research aims to investigate the complex interplay among patient rights, genetic testing, and cloud computing, with a particular emphasis on the legal contexts that govern these fields. Individuals must possess the ability to properly interact with health-related information and understand the economic components of digital platforms. Genetic testing and cloud computing are two areas where these literacies overlap, presenting distinct difficulties and opportunities. Legal considerations cover a wide range of issues, from data privacy and security to regulatory compliance and intellectual property rights. There are also implications for long-term economic growth, particularly in the area of health and well-being. A special economic zone exists at the Hainan Free Trade Port. In addition, this research explores how digital technologies may improve healthcare while considering the security precautions and ethical issues that must be taken to promote sustainable development through genetic testing. It also looks at how genetic data can be used to provide individualized economic outcomes and the roles that artificial intelligence and privacy play in these intertwined domains. The emergence of Web 2.0 has brought about a significant transformation in the digital realm, enabling individuals, businesses, and communities to leverage cutting-edge technologies for benefits in the social, economic, and environmental spheres, and advance sustainable progress. This study examines the opportunities and challenges presented and offers insights into the development of strong legal frameworks and moral standards, as well as the responsible application of these innovations for the benefit of society as a whole. This research will highlight how crucial it is to foster a more sustainable future through digital inclusivity, cooperative problem-solving, data-driven decision-making, and worldwide sustainable practices.

Keywords: digital economy; Web 2.0; sustainable development; digital technologies; digital health; genetic testing; law; cloud computing

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1. Introduction

The core of the Web 2.0 landscape is the emphasis on user engagement and collaboration. Presently, platforms and tools actively promote user participation, sharing, and interaction with content rather than passive consumption. The digital economy and the sustainable development of the Hainan Free Trade Port (HFTP) is significantly shaped by technologies, as demonstrated by the strategic ambition of the Chinese government to create a hub for sustainable economic development and international trade [1]. This research explores how numerous facets of the port's development and operations are impacted by cutting-edge technology like cloud computing, Web 2.0 platforms, and genetic testing. The HFTP offers new potential to develop the biotechnology and medical sectors, thanks to the revolution in customized medicine and healthcare brought about by genetic testing [2]. The widespread adoption of Web 2.0 technology has also made it easier for people to

collaborate and communicate across borders, which has aided in the port's incorporation into international value chains. This research also examines the legal and regulatory issues raised by these technological developments, emphasizing the necessity of contemporary legal agendas to guarantee the ethical and responsible use of technologies. It also aims to offer insightful information to researchers, business executives, and policymakers who are interested in leveraging technology to promote sustainable economic growth in the digital era and protect the privacy of genetic testing under digital law [3].

This change has led to the proliferation of user-generated content, ranging from blogs and social media posts to collaborative wikis and online reviews. Moreover, the Web 2.0 ecosystem prioritizes interactivity, providing real-time feedback, customization, and improved user experiences through web-based applications. This study discusses the prospects for digital healthcare in the future. With the potential advantages of cloud computing in storing and analyzing genetic data effectively, genetic testing services have grown in popularity among both consumers and medical professionals [4].

The special economic zone has aggressively pushed the development of genetic testing technology as a pioneer zone for digital technology and a testing ground for institutional innovation, intending to leverage the "spark" of regional legislation to start a "wildfire" for global genetic technology and digital development [5].

The legal issues about data privacy, consent, and security must be addressed immediately as genetic testing becomes more widely available and essential to healthcare [6]. The world of genetics, technology, sustainable development, and law is a dynamic and complex one that demands a thorough examination of the legal frameworks, ethical issues, and privacy rules that oversee it [7]. Cloud computing is at the forefront of technological developments brought about by the exponential growth of the digital economy. Cloud computing is a desirable option for businesses and people looking to take advantage of genetic testing since it provides a scalable and affordable platform for data processing and storage [8]. Genetic testing services can give quick results, encourage data sharing, and make it easier for academics and digital healthcare professionals to collaborate by utilizing the power of cloud computing. However, genetic data is sensitive by nature, which has significant ramifications for an individual's security and privacy [9]. The model below offers a basis for comprehending fundamental facts about legal matters, the digital economy, genetic testing, and the cloud computing environment.

The Web 2.0 era has seen the emergence of platform-driven business models, where organizations utilize user data and network effects to foster innovation and generate revenue. This data-centric strategy has revolutionized how businesses perceive and connect with their target audiences, creating opportunities for tailored marketing, personalized offerings, and data-driven decision-making. Genetic testing in cloud computing systems is governed by a patchwork of laws that differ from jurisdiction to jurisdiction, making it difficult for providers, consumers, and regulators to manage. Questions of data ownership, informed consent, data breaches, and potential discrimination based on genetic information are brought up by the convergence of the digital economy, cloud computing, and genetic testing. Many of these concerns are still unclear in the current legal landscape as of the knowledge cutoff date, which results in gaps, overlaps, and possible contradictions in the regulatory framework. Furthermore, the creation of suitable legal and ethical criteria frequently lags behind the quick speed at which blockchain technology advances [10]. A privacy policy is an essential document in the digital age that provides a framework for gathering, utilizing, and safeguarding personal information about individuals. It is a formal declaration of an organization's dedication to protecting users' right to privacy, covering the collection, use, and security of personal data. Privacy policies are ubiquitous in our increasingly digital environment, whether you interact with an online digital healthcare provider, social networking platform, or e-commerce site [11,12]. With worries over data breaches, cyberattacks, and improper data management on the rise, privacy rules are essential to building confidence and openness. In a time where data-centric decision-making is the norm, privacy policies enable people to make educated decisions regarding the manage-

ment of their data. A complex web of legal requirements, such as the California Consumer Privacy Act (CCPA) and the General Data Protection Regulation (GDPR), influences these decisions. Organizations must ensure that their policies comply with these rules to reduce potential legal risks and safeguard the data rights of persons.

The rapidly evolving field of digital health, which combines blockchain technology and healthcare, is changing how we identify, treat, and manage medical diseases [13]. It includes a wide range of technological advancements, such as sophisticated medical imaging systems, telemedicine platforms, wearable gadgets that track vital signs, and diagnostic tools driven by artificial intelligence. Digital health is becoming more and more critical in today's fast-paced world for lowering costs, boosting the effectiveness of digital healthcare delivery, and improving patient outcomes. It provides new opportunities for preventive care and personalized medicine, empowering both patients and healthcare professionals [14]. Moreover, pharmacological, genetic, and medical treatment research and development are being driven by digital health. Customizing treatments based on each patient's distinct genetic composition and medical background is enabling precision medicine [15]. Digital healthcare stakeholders are gaining important insights into illness trends, treatment effectiveness, and population health thanks to the power of big data and advanced analytics. To illustrate the complex ramifications of these legal concerns, real-world case studies, as well as the viewpoints of advocates for data privacy and healthcare professionals, are used. To develop best practices, standard industry stakeholders, legal experts, and policymakers must work together and monitor the legal context, improve data protection measures, and provide more evident consent processes. Cloud computing, genetic testing, and the digital economy form a dynamic nexus with significant societal ramifications [16]. This research looks into and aims to advance knowledge of privacy laws, moral dilemmas, and legal issues that are specific to this field, providing direction for a more morally and securely connected future concerning genetic testing in the digital economy.

2. Literature Review

Cloud computing has become a disruptive force that has a significant effect on the digital economy in today's digital landscape. A wealth of research highlights how cloud computing, defined as internet-based, on-demand access to computer resources, has completely changed the commercial landscape. Its implications are many and include increased security and compliance, cost-effectiveness, global accessibility, and innovation acceleration through data analytics [17]. The inception of the Web 2.0 landscape has been a subject of extensive academic discussion in recent decades. Scholars have endeavored to comprehend the fundamental changes in how individuals, businesses, and communities interact with the Internet and digital technologies. However, it also points to issues with cybersecurity, data privacy, and fair access. Cloud computing, a key force behind digital transformation, is redefining how companies work together and compete, changing the face of the modern digital economy and highlighting the significance of tackling new issues to ensure its long-term viability and beneficial impact. Big data analytics has become more accessible because of cloud computing, and research in this area shows how businesses may quickly analyze and examine large datasets in real-time to obtain valuable insights about consumer behavior and industry trends. Numerous studies have highlighted how cloud services eliminate the need for pricey on-premises equipment, enabling startups and small businesses to affordably access the same processing capacity as their larger competitors [18]. Scalability is made more accessible by cloud computing, which lets companies expand or contract resources based on demand, which ultimately improves cost-effectiveness. The transformative effect of cloud computing on the digital economy has been extensively discussed in the scholarly literature on the digital economy.

Although the significance of technologies in the digital economy and for sustainable development has been studied and the legal issues have been examined, little research has been conducted to specifically express how these aspects intersect at the Hainan Free Trade Port. By examining how cutting-edge technologies like cloud computing, Web 2.0,

and genetic testing affect the long-term development of the HFTP, this study seeks to close this gap in digital law. Together with examining the specific policy environment and development objectives of the port, it will also look at the legal and regulatory bases required to secure the proper use of these technologies in the present and future [19].

Acknowledged for popularizing the term "Web 2.0", emphasizing the shift from a static, publisher-controlled web to a more dynamic, user-centric platform. Subsequent research has delved into the essential features of the Web 2.0 environment, including the emergence of user-generated content, the proliferation of interactive and collaborative web applications, and the growing prominence of platform-based business models [20]. The widespread use of digital technologies marks a new age of economic activity, and the digital economy has brought about the Internet. This study explores the intricate web of legal issues in the digital economy and the changing complications brought about by the quick development of blockchain technology [21]. One of the most important of these issues is data privacy, which has been extensively studied concerning the consequences of data breaches, the necessity of strong data protection laws, and the difficult balancing act between individual rights to privacy and commercial interests. Intellectual property rights are also quite important. Copyright infringement, patent trolls, and the potential answers offered by blockchain and smart contracts are some of the topics that are frequently discussed. Studies show how susceptible digital infrastructures are to assaults, making cybersecurity issues critical and emphasizing the need for creative solutions to protect sensitive data. Scholars have also explored the societal and organizational impacts of the Web 2.0 environment, such as its influence on knowledge dissemination, consumer behavior, and corporate communication strategies. Furthermore, academics have underscored the difficulties presented by the Web 2.0 environment, encompassing concerns regarding data privacy, security, and the ethical utilization of user-generated content [22,23].

2.1. The Use of Genetic Testing in Healthcare

A vital element of the genomic era, genetic testing has grown more and more critical to the digital healthcare sector. It provides a thorough analysis of the complex function of genetic testing and sheds light on its increasing importance in both research and practical application [24]. Finding genetic variants linked to treatment response, illness susceptibility, and preventive measures is the primary goal of genetic testing. Research has demonstrated that it plays a crucial role in the early identification of diseases, providing medical professionals with the ability to customize treatment plans based on a patient's genetic composition and improving patient outcomes. Its influence extends to pharmacogenomics, where it makes it possible to choose drugs that are most appropriate for a person's genetic profile, maximizing therapeutic efficacy and reducing side effects. Furthermore, genetic data has become increasingly important in clinical practice for risk assessment, particularly in hereditary disease and familial cancer predisposition instances. However, there are also societal, legal, and ethical issues that need to be carefully considered. In particular, informed consent requirements and privacy considerations are crucial. The crucial component of genetic counseling help patients make educated decisions by helping them comprehend the implications of their test results [25]. The function of genetic testing in the medical field is constantly changing. It has a well-established role in risk assessment, individualized treatment, and early diagnosis. This demonstrates the growing significance of genetic testing in the healthcare sector and the need for ethical considerations to support its responsible usage and sustainable growth.

2.2. Cloud Computing Environments' Privacy Regulations

Cloud computing privacy policies are an important and developing aspect of the digital world. This review offers a thorough investigation of the dynamic interplay between privacy laws and the quickly developing field of cloud computing. Cloud computing has created new opportunities and difficulties for data privacy due to its remote data processing, storage, and accessibility [26]. A wealth of research demonstrates that to protect

user data, reduce risks, and guarantee regulatory compliance, clear privacy policies and practices are essential. Academics emphasize how difficult it is to strike a compromise between the need to protect sensitive data and the affordability and convenience of cloud services. This study also explores the complexities of privacy-related rules, emphasizing historic statutes like the Health Insurance Portability and Accountability Act (HIPAA) in the healthcare industry and the GDPR in Europe. It also talks about new technologies that have the potential to improve cloud data privacy, such as homomorphic encryption and changing data protection frameworks. Global privacy rules are also greatly influenced by the international legal environment (ISO) [27], which is molded by accords like the EU–US Privacy Shield and international data protection standards established by agencies like the International Organization for Standardization [28].

2.3. Both Digital Health and the Economy

The healthcare industry is being significantly impacted by digital health, which is now a crucial part of the developing digital economy. This study sheds light on the transformative forces at work by examining the intricate interactions between digital health and the digital economy. A vast range of advancements are included in the field of digital health, including wearable technology, telemedicine, health informatics, and artificial intelligence [29]. Studies highlight how these blockchain technology developments have transformed the delivery of digital healthcare by permitting real-time data analysis, enabling remote patient monitoring, and encouraging more patient-centered care. Along with improving patient access, the growth of telehealth services, electronic health records, and health applications has also produced new commercial opportunities. These advancements reduce digital healthcare expenditures while improving diagnosis, treatment, and preventive care [30]. The literature does, however, also address the difficulties, such as worries about the digital divide, regulatory compliance, and data security. Global norms for data privacy and digital health interoperability are being established via international agreements like the WHO's framework for eHealth and European regulations like the GDPR. The rise of health tech businesses, the development of the health tech ecosystem, and the modification of regulatory frameworks to keep up with these developments demonstrate the influence of digital health on the digital economy [31].

Although genetic testing has advanced significantly, there are still intricate regulatory issues that this analysis aims to clarify. In recent years, there has been a surge in interest in genetic testing, which examines a person's D.N.A. to provide insights regarding their health, lineage, or susceptibility to specific disorders. According to research, comprehensive regulatory frameworks that ensure patient protection, ethical use, accuracy, and data security are necessary to oversee genetic testing. Research highlights the significance of instituting strict quality guidelines, mandating genetic counseling, and implementing informed consent protocols. Significant international and national legislation, such as the GDPR of the European Union and the Genetic Information Nondiscrimination Act (GINA) of the U.S.A., have established precedents for protecting genetic information from exploitation and discrimination [32,33]. Although these rules offer a starting point, the rapid advancement of blockchain technology has spurred additional conversations on topics such as genetic testing available directly to consumers, genetic information accessibility, and the role of medical professionals.

2.4. Patients' Rights and Privacy Concerns

In the context of healthcare, privacy issues and patient rights protection have become critical factors, especially in the age of digital health and electronic medical data. Research has explored the complex issues and moral dilemmas that come with the increasing use of blockchain technology in healthcare, as well as the complex link between patient rights and privacy. Legal and ethical frameworks in healthcare protect patients' rights to confidentiality and govern who has permission to access their medical records [34]. However, the introduction of telemedicine, electronic health records, and health information sharing

have sparked worries about patient data protection, security breaches, and illegal access. To protect patient information, experts stress the necessity of strict safeguards like solid data encryption, access controls, and legislative frameworks like the GDPR of the European Union and the HIPAA of the U.S.A. Research highlights the significance of preserving patient autonomy, informed consent, and data security to guarantee that patient rights are respected in this fast-paced, technologically driven healthcare setting, even while digital health innovations have great potential to improve healthcare delivery [35].

Legal difficulties in the globalized digital era transcend national borders, requiring international approaches to meet the complex issues brought forward by the constantly changing digital landscape. [36]. This research examines the intricate world of international law, highlighting the necessity of law and regulatory harmonization, standardization, and cooperation. Scholars emphasize the increasing importance of global accords and structures, best represented by programs like the European Union's GDPR, which established standards for cybersecurity, privacy, and data protection [37,38]. Global blockchain technology businesses, e-commerce, and cross-border data flows define the digital economy, which highlights the need for international agreement on matters such as cybercrime, data sovereignty, and intellectual property.

2.5. Health law in Hainan Free Trade Port

Article 12: High-standard port infrastructure construction is required at the Hainan Free Trade Port, along with tighter oversight of food safety, biosafety, public health, and commodities quality and safety at the ports.

Article 39: To promote new forms and models of tourism, the Hainan Free Trade Port will develop into a global hub for travel and consumption that closely integrates tourism with culture, sports, healthcare, elder care, and other sectors [39].

Article 55: The law establishes the security assessment system for foreign investment in the Hainan Free Trade Port, and security reviews will be carried out for foreign ventures that impact or have the potential to impact China's national security. The establishment of a robust financial risk prevention and control system, the deployment of a hierarchical cybersecurity protection system, the establishment of a risk prevention and control system for people movement, a monitoring and alert mechanism for infectious diseases and public health emergencies, and a mechanism for prevention, control, and treatment in the event of an outbreak are all necessary to maintain order and security in the domains of finance, networks and data, movement of people, and public health in the Hainan Free Trade Port [40].

3. Experimental Protocol

This study employs a range of research sources with the primary goal of investigating interconnected patterns in legislation. It was accomplished by a review of academic papers published in esteemed legal journals, including the *International Journal of Law and Information Technology*, *Yale Law Journal*, and *Harvard Law Review*. Furthermore, documents released by credible organizations such as the World Intellectual Property Organization (WIPO) [41], the International Data Corporation (I.D.C.), or the European Commission can offer insightful information about the legal aspects of the digital economy and cloud-based genetic testing [42]. Analyzing current legislative contexts governing cybersecurity, data protection, privacy, and intellectual property in the context of the digital economy is part of the inquiry, especially as it relates to genetic data processed and stored on the cloud. Comprehending the needs of regulatory compliance, such as the General Data Protection Regulation (GDPR), is crucial, as is HIPAA [43]. The study investigates the moral ramifications of cloud-based genetic data ownership, access, and use. Evaluating the encryption standards and security measures in place in cloud computing for genetic data is essential to guarantee compliance and reduce the danger of data breaches or illegal access and research methods. Table 1 identifies similarities and valuable insights for the research on the digital economy and genetic testing in the cloud computing environment that can

be gained from examining pertinent legal cases or precedents concerning genetic testing, cloud computing, and data privacy.

Table 1. Basic Information on Research Focus.

Type	Topic Queries	Legislation	Year of Data
Individually gathered research	Cloud Computing & Legal Issues	The Ancient Chinese Legislation	From to 2023
	Cloud Computing & Genetic Testing	The Modern Chinese Legislation	From to 2023
	Cloud computing & Digital Economy	The United States of America's Legislation	From to 2023
	Cloud computing & Security Privacy	The United Kingdom's Legislation	From to 2023
	Cloud Computing & Healthcare	The European Legislation	From to 2023

What legal concerns about data security, privacy, and the ethical use of personal information should Web 2.0 environment developers, legislators, and regulators consider regarding digital health technologies like cloud computing and genetic testing?

The approach and objectives of this work involve formal legal analysis and synthesis. It offers a thorough examination of genetic and legal testing, cloud computing, and the interplay of financial risks in business ventures [44]. Additionally, it focuses on these goals by providing worldwide data exchange and cooperative processing inside an easily adjustable, scalable structure. This paper aims to accomplish the following: (i) Research the characteristics and legal aspects of genetic testing in the context of cloud computing, as well as identify dangers and threats. This is thought to be a fruitful avenue for developing the legal regulation framework for the digital blockchain technology sector. Significant progress has been made in the area of data protection by the U.S., China, U.K., and E.U. Scholars from all around the world have paid close attention to these data privacy regulations, which are seen as significant turning points for specific countries or areas. As such, the regulations chosen to guide the evolution of cloud computing in genetic testing are relevant to this field. They support the digital economy. (ii) Investigate potential legal recourses and recommend guidelines to address the identified moral and legal difficulties. (iii) This study's findings may be helpful to experts in risk management, the digital economy, jurisprudence, and lawmaking. (iv) Outline how the wise use of federated and hybrid clouds can help close the gap between dispersed individual solutions and a "one-size-fits-all" approach in genomics research. (v) The authors emphasize that research in genomics and genetics can benefit significantly from the responsible use of federated and hybrid clouds. This approach can be utilized as a middle ground between fragmented individual solutions and "one-size-fits-all" solutions. (vi) Analyze the impact of cloud computing on the legal framework of medical technology and genetic testing. (vii) Analyze the ethical concerns brought up by cloud computing's use in the digital market for genetic testing.

3.1. Analysis Measures

This study's analysis methods took a broad approach to comprehending the legal framework for genetic testing in cloud computing environments. It required a careful analysis of the unique characteristics and legal nuances related to genetic testing in the context of cloud computing, with an emphasis on identifying potential risks and threats in this area. The digital economy, on the other hand, refers to the full spectrum of social and economic endeavors made possible by the Internet and other digital technologies. This research delves into investigating workable legal remedies and developing policy suggestions to address the recognized legal obstacles and moral dilemmas that emerge in this situation [45]. The conclusions are intended to provide insightful viewpoints for a broad spectrum of investors, including specialists in risk management, digital economy, jurisprudence, and legislative context forming. This study assessed the ethical use of federated and hybrid clouds as a fair and long-term method of carrying out genomics research in the cloud. This report includes a thorough examination of how cloud computing impacts the legal agenda that governs digital health and genetic testing in-laws. The goal of the research is to report the ethical, legal, and sustainability issues while resolving the

conflict between utilizing the advantages of the digital economy, digital health, and cloud computing. Additionally, to provide a thorough grasp of the ethical implications and considerations inherent in this rapidly changing technological landscape, the study closely examines the ethical dimensions associated with using cloud computing for genetic testing within the digital economy [46,47]. By using these thorough analysis techniques, this study aimed to provide significant insights into the developing conversation about the moral and legal implications of genetic testing in the context of cloud computing, helping to guide the creation of policies and decisions in this quickly developing field.

3.2. Data Confidentiality and Security

According to the A.P.A., privacy is the ability to limit who can enter one's personal space, both physically and psychologically. This control includes controlling outgoing communication, including the volume and type of personal information released, and controlling incoming information through physical barriers like doors and partitions [48]. The condition of restricted access to personal data is known as "informational privacy" (Figure 1). A breach of privacy occurs whenever someone's private information is made available to another party, either by reading, listening, or in any other way. It is like getting an unexpected look at someone's "virtual self". The idea of informational privacy is dynamic, and very few people can exercise total control all the time. Cloud providers are required to protect data privacy and people's right to control how their personal information is collected and used. As blockchain technology develops and spreads, protecting information privacy becomes more difficult because of the increased amount of data being collected and shared [49]. The possibility that cloud computing organizations may unintentionally process personal data without awareness is known as the "cloud of unknowing."

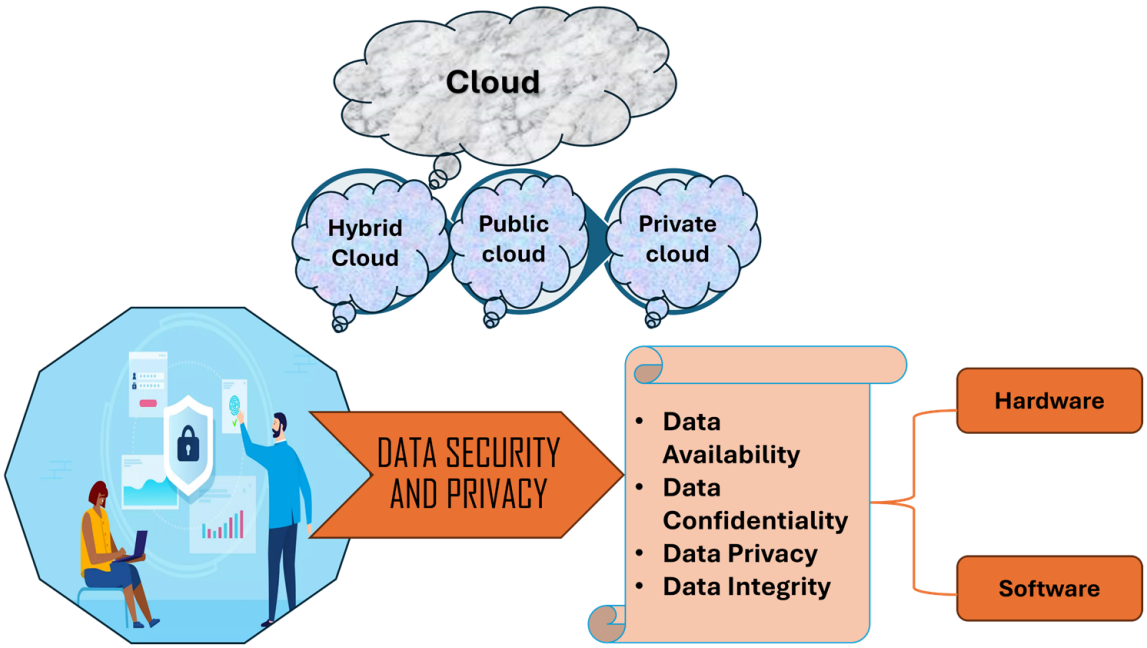


Figure 1. General of Advanced Engineering Technologies and Sciences on a Global Scale.

3.3. Evaluation of the Growth of the Digital Economy

With an emphasis on the digital economy, the Group of Twenty (G20) drew on significant research findings from a variety of sources, including the OECD, Xiang Shujian [50], and Wu Xiaoyi's work on the digital economy evaluation index system, as well as Wu Wenjun from the China Academy of Information and Communications Technology. When choosing metrics that are strongly associated with the digital economy, the G20 took data availability and reliability into account. As a result of this thorough procedure, a three-

tiered digital economy assessment index system was developed, which includes indications from the input and output viewpoints (Table 2). Three key indicators—digital intake, digital environment, and digital output—were found within this multifaceted assessment method. The assessment framework created for this study is built around these elements. A digital economy index was developed by applying the entropy approach to assess the level of development of the digital economy in 30 regions across the country [51]. From the standpoint of sustainable development, the special economic zones' cutting-edge core technologies, healthy ecological surroundings, dynamic economic activity, and stable social order offer a strong basis for drawing in investment and boosting exports. The special economic zones stand out among them in that they highlight the enormous potential that technology innovation offers for economic growth. The Dubai Free Zone, for instance, is dedicated to building a competitive knowledge-based economy [52].

Table 2. Evaluation Scale for Digital Economic Growth.

1st Level Core Indicator	2nd Level Core Indicator	3rd Level Core Indicator	4th Level Core Indicator Clarification
Digital outcome	Digital consequence	Societal advancement	Urban development pace. Personal income for expenditure.
		Mobile platform	Mobile network capacity. Smartphone prevalence rate
		Operational efficacy	Proportion of G.D.P. from the information service industry. Profitability margin.
		Development of digital skills and investment	Information sector employment rate. Intensity of R&D staff input.
		Ecological perks	Urban sewage processing rate. The safe processing rate of urban solid waste
		Investment in digital innovation	Market turnover in technology
	Blockchain technology and communication utilization	Firm	Proportion of companies with websites. Rate of companies involved in online transactions.
Digital protection		Digital protection	Owned domains.Web assets.
Digital sphere		Digital commerce	Contribution of online sales to regional G.D.P. Rapid quantity
Digital expenditure		Data insertion	Internet connectivity rate per population. Total web page holdings
		Security of digital policy system	Computer assets
	Digital creativity	Investment of funds	Depth of research investment. Percentage of investment in the service industry.
	Digital framework	Internet Infrastructure	Broadband entry point. Cable network length.
	Individual		Count of digital television users. Telecom consumption per capita.
Unauthorized access, hacking, and cyberattacks aimed at breaching digital security systems.	Retrieval. Architectures designed for data retrieval.	The legal regulations that oversee the retrieval and usage of data determine the system's access protocols.	Data classification in economic terms, such as categorizing it as a public good, private good, club sound, etc.

3.4. Development of Legislation

Understanding discourse entails creating a legal issue representation with an emphasis on the ensuing laws about important legal domains relating to cloud computing, security, and privacy agreements, genetic testing evaluations, and healthcare management (Table 3). It highlights the specific problems that competition law must solve for each of these categories, and market power has to be defined more precisely in the context of digital platforms, the study of cross-market foreclosure tactics in the digital economy, as well as distinct guidelines for evaluating market dominance in digital platforms [53]. According to Article 1, the purpose of this law is to create a high-standard, Chinese-style Hainan Free Trade Port, enable the establishment of new frameworks for higher-level reform and opening up, and support the steady, robust, and long-term growth of the socialist market economy.

Table 3. Creation of New Regulations.

Theme	Year	Legislative Outline
China		
Cloud computing	2017	• To encourage interoperability and security, the Chinese government released several cloud computing standards and guidelines. Standards are intended to guarantee that cloud service providers follow legal obligations and best practices [54]. • The significance of cybersecurity laws. China's comprehensive cybersecurity law is called the Cybersecurity Law of the People's Republic of China (C.S.L.). The National People's Congress Standing Committee approved it in 2017 [55]. Cloud computing security was categorized and regulated with the introduction of the Multi-Level Protection Scheme (MLPS) [56]. Adopted in November 2016 and going into effect in June 2017, the Cyberspace Administration of China (C.A.C.) actively participated in establishing standards and guidelines for cloud service providers to guarantee data security, privacy, and compliance with local regulations [57].
Digital economy	2021	• China has been actively developing laws to control its expanding digital economy. One such law was put into effect in 2019 and addressed e-commerce activities in China. It covered topics like artificial intelligence, platform liability, consumer rights protection, online payments, e-commerce operators' responsibilities, and the Internet of Things [58]. • The Personal Information Protection Law, which was also passed in 2021, attempts to safeguard people's data. It specifies guidelines for obtaining consent for data collecting, restricting data processing, granting people control over their data, and prohibiting cross-border data transfers [59].
Genetic testing	2019	• The gathering, storing, and utilization of human genetic resources are subject to stringent regulations in China. The 2019 Regulation on the Management of Human Genetic Resources places a strong emphasis on genetic data protection and calls for particular authorization before any genetic materials can be collected, exported, or shared [60].
Security privacy	2021	• Its goal is to control data processing, storage, and transmission inside China. This law deals with matters pertaining to data classification, security, privacy, and protection for data processors [61].
Healthcare	2009	• The fundamental ideas and structure for healthcare services and health promotion are delineated in this law. It addresses issues like public health campaigns, basic health insurance, and accessibility to healthcare [62].

Table 3. *Cont.*

Theme	Year	Legislative Outline
U.S.A.		
Cloud computing	2018	• The act deals with law enforcement access to cross-border data. It enables global data-sharing agreements and gives U.S. law enforcement agencies access to data that U.S. tech corporations have stored abroad [10,63].
Digital economy	1996	• Although there may not be a single complete law, there have been continuous talks and proposals regarding a number of topics in the digital economy, such as cybersecurity, e-commerce, digital taxation, and intellectual property rights, without any legislation being passed [64].
Genetic testing	2008	• GINA forbids discrimination in employment and health insurance based on a person's genetic information. However, developments in genetic testing blockchain technology could spur conversations about modernizing or enhancing current laws [65].
Security privacy	2021	• A number of states have proposed or enacted their privacy legislation, such as the Virginia Consumer Data Protection Act (VCDPA) and the California Consumer Privacy Act (CCPA). Comprehensive privacy legislation has been discussed at the federal level, and Virginia (VCDPA) has established its own privacy rules. The year 2020 saw the implementation of the CCPA and the enactment of the VCDPA [66].
Healthcare	2010	• Even though there may not have been any recent comprehensive healthcare legislation at the federal level, a number of laws and initiatives have been discussed in relation to ongoing efforts to enhance healthcare. For instance, the 2010 enactment of the Affordable Care Act (A.D.A.) sought to reduce healthcare costs and increase healthcare coverage.
Theme	Year	Legislative Outline
U.K.		
Cloud computing	2018	• GDPR has a substantial influence on data handling, including data saved in the cloud, even if it is not explicitly related to cloud computing. It ensures a standard data protection norm for both the E.U. and the U.K. [67] • National Cyber Security in the U.K. A number of policies and procedures have been put in place to handle cybersecurity issues, which are strongly related to cloud computing security [68].
Digital economy	2017	• Although these are E.U. legislations, the U.K. may decide to adopt comparable policies or cooperate with these acts in order to control digital services and markets that fall under its purview [69].
Genetic testing	2028	• In the U.K., regulations about genetic testing may be governed by more general healthcare and data protection laws, such as the Data Protection Act 2018, as well as rules issued by organizations like the Human Fertilization and Embryology Authority (HFEA), which is in charge of regulating reproductive therapies and embryo research [70].
Security privacy	2016, 2018	• Legislation incorporates privacy protections and controls how law enforcement and security organizations use their surveillance capabilities. • Data Protection Act 2018: This act enforces GDPR standards within the U.K. and regulates how personal data is processed and protected.
Healthcare	2012	• The Health and Social Care Act of 2012 brought about notable modifications to the NHS's structure in England by encouraging competition among healthcare providers and placing a strong emphasis on patient choice. • Digital and Information Strategy: Efforts to enhance digital healthcare services and information exchange within the NHS have been continuing [71].

Table 3. *Cont.*

Theme	Year	Legislative Outline
E.U.		
Cloud computing	2018	• By establishing strict guidelines for the processing and storage of personal data, this legislation pertains to data protection and has an impact on cloud computing services.
Digital economy	2020	• These acts, which were proposed in late 2020 and are presently being discussed and put through the legislative process, are intended to control digital services, online platforms, and competition in digital marketplaces [72].
Genetic testing	2017	• The IVDR controls medical equipment, including genetic testing kits, to ensure their function and safety, even though it is not exclusively focused on genetic testing [73].
Security privacy	2018	• The ePrivacy Regulation, which focuses on electronic communications and privacy rights, is meant to supplement GDPR. Talks about it have been ongoing [74].
Healthcare	2011, 2020	• The purpose of this directive is to make it easier for patients to receive healthcare services in other E.U. nations and have their home country pay for those treatments [74]. • This is a new policy aimed at supporting innovation, fortifying the pharmaceutical sector, and guaranteeing E.U. citizens' access to inexpensive, safe medications.

3.5. Leveraging Cloud Computing into Hainan Free Trade Port

This paper will examine how genetic testing can assist individualized healthcare services for Hainan Free Trade Port residents and guests, considering privacy concerns, the moral use of genetic data, and integration with the larger healthcare system. An important project for China's economic growth is the Hainan Free Trade Port, which intends to make the island province a hub for free trade worldwide. The experimental protocol describes strategies for utilizing state-of-the-art technology, such as cloud computing, to enable smooth international investment and trade. Additionally, it discusses how genetic testing might help provide residents and guests with individualized healthcare services [75]. The protocol highlights how crucial it is to maintain data security, privacy, and regulatory compliance while integrating these cutting-edge technologies into the daily operations of the free trade port. The intention is to construct a technology-driven, sustainable growth model that can be applied to other free trade zones worldwide.

4. Discussion and Analysis

China has been actively pushing digital technology development to align with global advanced technology development and reform efforts. Furthermore, a positive trend has emerged since 2013, when a series of free trade ports and pilot zones were established, leading the way in high-tech fields. Hainan Free Trade Port is one of them, and encourages the deep integration of genetic technology research and the innovation chain, with a focus on scientific and technical innovation. The impending complete island closure and the implementation of the Regional Comprehensive Economic Partnership (RCEP) would create favorable circumstances for enhancing Hainan's degree of openness and encouraging the incorporation of genetic technology that meets international standards [76].

The different legal frameworks in China, the U.S.A., the U.K., and the E.U. represent different perspectives on technological governance and social well-being. China stresses data security with significant cybersecurity legislation and stringent restrictions in areas such as cloud computing, genetic testing, and protecting personal information [77]. The U.S.A. oversees a patchwork of laws, including state-level privacy protections, to address issues with cross-border data access and privacy. While creating its national cybersecurity strategies and healthcare reforms, the U.K. is taking E.U. directives like GDPR into consideration. Through proposed acts like D.S.A. and D.M.A. and unified standards like GDPR, the E.U. is leading the way in creating harmonized standards for digital services, genetic testing, and data protection.

These legislative contexts reflect shifting societal demands and technological surroundings, which in turn show different priorities and methods. The legal systems in these countries handle the complicated problems of genetics, technology, privacy, and healthcare through a range of strategies and focal points. China's legislative policy takes a proactive approach to data protection, as evidenced by its strict cybersecurity policies and regulations, by creating comprehensive rules for cloud computing, with a focus on interoperability, security, and regulatory compliance among service providers. China's stringent regulations on genetic testing, which are detailed in the 2019 Regulation on the Management of Human Genetic Resources, prioritize the privacy of genetic data and have strict authorization requirements for collection and distribution [78]. The transformation that the World Wide Web has experienced over the last twenty years has been significant, shifting from a static source of information to a more interactive and user-focused environment known as Web 2.0. This evolution, initiated in the early 2000s, has had a profound impact on how individuals, businesses, and communities interact with online content and services.

China's digital economy was formally linked to the Internet in 1994. Due to the rapid growth of social media and e-commerce over the past ten years, China's digital economy has expanded steadily [79]. Since the 18th National Congress, the C.P.C. Central Committee has put out several strategic objectives for expanding the digital economy. In addition to adding data as a factor of production in the fourth plenary session of the 19th C.P.C. Central Committee, it released the comprehensive blueprint for the digital economy in the 14th Five-Year Plan and the Long-Range Objective through the Year 2035, which guides China's digital economy towards high-quality development [80]. China's digital economy rose from CNY 11 trillion to CNY 39.2 trillion in 2020, or 38.6% of GDP, during the 13th Five-Year Plan era, according to the China Academy of Information and Communications Technology's White Paper on China's Digital Economy Development [81]. China's economy has developed at a faster rate than other economies, primarily due to the digital economy, whose main achievements fall into six areas, including increasing the industrialization of digital technology, extending areas of discussion based on new models, developing new forms of digital industry, and strengthening new industrial development (Table 4).

Table 4. The model presents basic information below.

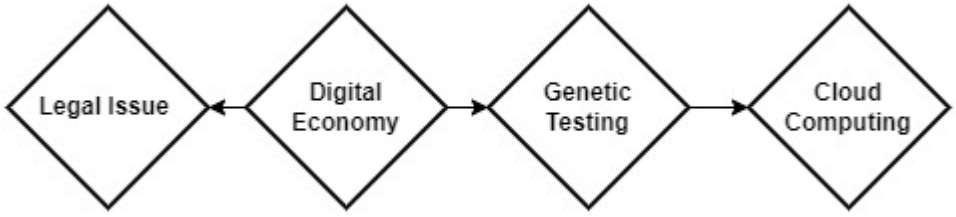
Digital Technologies: A Legal Future Perspective	
As a pioneer zone for digital technology and a test field for institutional innovation, the special economic zone has vigorously developed genetic testing technology, hoping to use the "spark" of regional legislation to create a "wildfire" for global genetic technology and digital development.	
No	 1 2 3 4
1	☐ Give a summary of the significant legal concerns about genetic testing, the cloud computing environment, and the digital economy. ☐ The significance of tackling these legal matters is to guarantee moral behavior, safeguard confidentiality, encourage equitable competition, and stimulate creativity.
2	☐ The digital economy and its significance in today's society. ☐ Describe the key elements and traits of the digital economy, including data-driven technology, digital platforms, online services, and e-commerce. ☐ The digital economy has legal issues and ramifications, encompassing areas such as cybersecurity, data privacy, intellectual property rights, consumer protection, and cross-border legislation.

Table 4. *Cont.*

Digital Technologies: A Legal Future Perspective	
3	☐ Provide an overview of genetic testing and its applications in healthcare, research, and personal genomics. ☐ Describe the legal aspects of genetic testing, including data ownership, informed consent, privacy protection, genetic discrimination, and regulatory compliance. ☐ New legal concerns surrounding genetic testing about cloud computing and the digital economy.
4	☐ Cloud computing and its role in the digital economy. ☐ Describe cloud computing's advantages and disadvantages, including scalability, cost-effectiveness, data storage, and security. ☐ The legal obstacles that cloud computing presents include those related to data privacy, data sovereignty, jurisdiction, contracts, and intellectual property rights.

The People's Bank of China and Economy & Data Science collaborated to develop China Score, the nation's national personal credit score system. China Score has become the market leader worldwide, with an accuracy rate that is 10% higher than FICO, a credit scoring system in the U.S.A., and considerably higher than other international systems. Commercial banks have made substantial use of the system since it went online to approve credit cards [82]. Designated regions inside a nation that are created to support economic growth and foreign trade are known as special economic zones. Relaxed rules, tax breaks, and other advantages aimed at luring foreign investment and promoting the growth of export-oriented sectors are typical characteristics of special economic zones [83].

4.1. Web 2.0 Environment

The Web 2.0 environment has fundamentally transformed the interactions of individuals, businesses, and communities with digital technologies and online platforms. The central aspect of this shift involves moving from a top-down, publisher-driven web to a more participatory, user-centric model of content creation and dissemination. One of the distinguishing features of the Web 2.0 environment is the emergence of user-generated content, where individuals actively participate in contributing, sharing, and collaborating on various digital assets, including blog posts, social media updates, online reviews, and collaborative wikis. This user-driven approach has democratized the online domain, granting individuals a more prominent voice and impact in molding the digital dialogue. In addition to the surge in user-generated content, the Web 2.0 environment has fostered platform-centric business models, where companies utilize user data, network effects, and interactive elements to promote innovation, monetization, and customer interaction. This data-centric approach has revolutionized how organizations comprehend and engage with their audiences, facilitating more tailored, precise, and flexible digital tactics. Nevertheless, the Web 2.0 environment has brought about new complexities, including apprehensions regarding data privacy, content regulation, and the ethical handling of user-generated content. Effectively navigating these intricate issues will be vital as the web progresses and transforms the digital terrain.

4.2. Measures for the Security of Health Data

China has inconsistent laws regarding information protection, most of which are legislative status quo stipulations, making it unable to sufficiently protect the personal health information of information subjects. Special laws about cloud computing and information security are, therefore, desperately needed. From the perspective of legislative models, typical examples of decentralized and unified law are the United States and the E.U., respectively. Debates based on uniform legislation overseeing information collectors' collection, use, and retention of personal data are under E.U. jurisdiction. The "right to personal health information" describes a person's legal capacity to control and thwart unwanted access to the information gleaned from their health status. The law clarifies

everyone's right to private health information. The right to access specified personal health information is what the right to personal health information is all about, and civil rights provisions define how much protection subjects have against legal interests [84]. A natural person is the subject of the right to personal health information. Thus, expanding on the specifics of a person's rights helps to make clear the legitimate rights and interests that the subject of health information enjoys, and establishes the foundation for the protection of personal health information by making clear the subject and purpose of that right to health. The usage of cloud computing has transformed the healthcare sector, making it more patient-centered and data-driven. Accessibility can be increased at a low cost through the use of medical data and cloud computing. These approved solutions may then be beneficial to industry and patients. Additionally, cloud technology can increase system agility, speed, and flexibility by eliminating the requirements for hardware or software supply and reducing the resources required for system maintenance, such as configuration, installation, and testing [85].

4.3. Cloud-Based Genetic Resources and Services

The Genetic Information Nondiscrimination Act (GINA) of 2008 is a crucial piece of legislation that prohibits group health plans and health insurance providers from discriminating against subscribers based on genetic information. Furthermore, it prohibits genetic data collection and requirements for genetic testing of members by health insurance companies and group health plans. However, medical record numbers are specifically listed as one of the identifiers that must be removed from data for it to be considered de-identified, so this restriction does not apply to them. Medical record numbers are inherently protected health information (PHI), regardless of their ability to identify a patient uniquely. The collection of identifiers that have to be removed from data for it to be deemed de-identified now includes this expansive definition of genetic information. Federal authorities have yet to explain this. There are significant implications for genetic material research when genetic data is designated as PHI, especially given how comprehensive that definition is. It also significantly affects how genetic data is managed within and outside of the company, mainly if it is kept on cloud storage. This is due to a discussion focused on medical data in general and genetic data in particular, which are often considered sensitive data that require stringent legal protections. As seen in our discussion of permission, data protection and privacy laws are crucial to preserving the confidentiality of personal files containing genetic information. For example, records kept by employers and insurers, as well as medical records, are subject to various federal and provincial legislation. With a few exceptions, genetic test data kept in a patient's medical or hospital record cannot be shared with employers or insurance companies without the patient's permission. The issue of privacy in the context of biomedical research is likewise covered by provincial and federal legislation. According to E.U. and U.K. rapporteurs, this legal maze rarely permits non-consensual publication.

4.4. Cloud Solutions That Are Outsourced in the U.K. and E.U.

There are several risks associated with using cloud technology that compromise data security. For example, the prevalence of I.C.T. security threats resulting from inadequate or ineffective internal processes or external events may eventually affect a firm's systems and data security. Indeed, numerous jurisdictions have implemented legislative and regulatory structures to manage cloud usage, aiming to avoid risks associated with technology, focus, unauthorized data processing and access, and security. The E.U. has greatly influenced talks on the global regulatory environment and cloud regulation in particular. As a result, the U.K., Germany, France, Italy, and Ireland are among the countries that have passed Internet and privacy regulations based on the concepts and institutional frameworks of European legislation. Many rules and regulations make up the fragmented and generally disjointed regulatory framework that governs cloud computing and structures of European legislation, including the U.K., Germany, France, Italy, and Ireland. The fragmented

and largely disjointed regulatory structure that oversees cloud computing is made up of numerous laws and regulations [86].

4.5. Observations

Concerns regarding data security and privacy have been brought up by the economy's fast digitization, especially in light of genetic testing and cloud computing in the healthcare industry. To safeguard individual rights and facilitate the advantages of digital health technologies, strong regulatory frameworks are required. Careful management of the shift to a digital economy is necessary to guarantee fair access and stop socioeconomic gaps from growing. To empower marginalized communities to engage in the digital economy and close the digital gap, strategies are needed. Navigating the complex difficulties at the convergence of digital health, digital economy, and emerging technologies like cloud computing and genetic testing requires interdisciplinary collaboration between policymakers, technologists, healthcare practitioners, and legal experts. Achieving sustainable development in the digital economy necessitates striking a balance between social inclusion, environmental sustainability, and economic growth. Green digital solutions should be promoted, and policies and programs should address how digital technologies affect the environment. The legal and regulatory environment of emerging technologies like cloud computing and genetic testing, as well as the digital economy and health, is changing quickly. Legal frameworks must be reviewed and updated often to ensure they remain current with technology and adhere to sustainability and public welfare.

5. Conclusions

Since the start of Web 2.0, the digital world has experienced unprecedented growth and sustainable development, enabling people, businesses, and communities to use digital tools for the benefit of the environment, society, economy, and cloud computing. These conditions present noteworthy opportunities for fostering long-term development. The Hainan Free Trade Zone's use of genetic testing and cloud computing technologies has the potential to transform scientific research, healthcare, and digital law. A favorable atmosphere for ground-breaking discoveries and individualized medical treatments is created by the availability of sophisticated genetic testing services and the zone's emphasis on scientific and technological innovation. Moreover, Hainan should have even more opportunities to raise its degree of openness and integration with international high-tech norms with the upcoming closure of the entire island and the execution of the Regional Comprehensive Economic Partnership (RCEP) agreement. The region's standing as a pioneer in genetic technology research and the digital economy would be further strengthened by this. All things considered, the results of this research highlight how technology, especially Web 2.0 and the digital economy, is transforming fields like genetic testing and supporting the sustainable growth of the Hainan Free Trade Zone. The region's future and its global significance are greatly promising due to the synergistic interaction between scientific advancement, economic liberalization, and technological innovation. This study has shown the enormous potential of digital technologies and the digital economy, especially in the rapidly evolving fields of genetic testing and digital health, to support sustainable development.

Limitations and Future Research Directions

The breadth of this research, which includes a wide range of subjects like the digital economy, digital technologies, genetic testing, and sustainable development, is one of its main drawbacks in Web 2.0. Although this scope enables a thorough study, it could also limit the depth of research in any particular field. Subsequent studies may concentrate on more focused analyses of the connections and exchanges among these many fields. The results of this study may also have a limited shelf life due to the fast-changing nature of digital technologies and the digital economy. It will take ongoing research to stay up to date with the constantly shifting terrain. The relevance and application of the research over time could be ensured with the aid of longitudinal studies and frequent updates

to the analysis. The possibility of regional or cultural variances in the application and effects of genetic testing, digital technology, and sustainable development programs is another drawback. Subsequent investigations may go deeper into these contextual elements, possibly employing cross-cultural analysis or comparative case studies. Ultimately, more research is necessary to fully understand the ethical and societal ramifications of genetic testing, digital technology, and the digital economy. Future research programs should prioritize issues like algorithmic bias, data privacy, and the fair distribution of the risks and benefits that come with these developments. Overall, this research offers a valuable framework for comprehending the intricate connections between digital technologies, the digital economy, and sustainable development; however, more research on these subjects is necessary to reap the rewards and lessen the drawbacks. Since the program is still in its early stages of implementation, the analysis of the Hainan free trade port is restricted by the availability of comprehensive and current data. Future studies should examine the long-term social and economic effects of free trade ports as well as the efficiency of certain legislative initiatives in luring capital and spurring innovation. Furthermore, conducting comparative analyses with alternative free trade zones or ports may yield significant insights into the distinct obstacles and prospects encountered by the Hainan model.

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