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Systematic Analysis of the Smart Economy Concept: The Industry 4.0 Challenges

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Abstract: One of the most important aspects of Industry 4.0, the idea of a "Smart Economy" is playing an important part in attaining the SDGs. This study examines the Smart Economy from every aspect, including its defining features, the cutting-edge digital tools it uses, and the positive effects it has on economic growth in the long run. Big data analytics, the Internet of Things (IoT), and artificial intelligence (AI) are the main areas of study because of their potential to improve economic openness, efficiency, and sustainability. The study's overarching goal is to show how the Smart Economy can help get us closer to the SDGs by looking at specific examples in fields like cybersecurity, urban planning, agriculture, and energy management. This goal was accomplished by conducting a systematic literature review that focused on articles published between 2018 and 2022 that had been peer-reviewed, as well as reports from the industry and case studies. Criteria for source selection included adherence to publication in credible scientometric databases (e.g., Scopus, Web of Science, and Google Scholar), relevance to Smart Economy and its components, and alignment with Industry 4.0 and SDGs. In order to discover Smart Economy trends, problems, and opportunities, the data from these sources was coded and analyzed thematically. The interdependencies among the three pillar technologies (AI, IoT, and big data), their respective application domains, and the effect they will have on the attainment of individual SDGs were also graphically depicted in a block diagram. The results demonstrated that smart technologies have substantial effects: smart lighting systems cut energy consumption by 40%, urban planning with AI and IoT reduced traffic congestion by 30%, and precision agriculture enhanced crop yields by 25% while reducing water use by 30%. Digital infrastructures are now more reliable and secure thanks to smart grid optimization of energy resources, which increased grid efficiency by 20% and decreased household energy consumption by 15%. Cybersecurity measures were also improved, leading to a 35% decrease in cyberattacks. Despite the Smart Economy's many advantages in reaching the SDGs, the study says that problems like data privacy and the digital divide must be solved before it can reach its full potential.

Keywords: artificial intelligence, cybersecurity, digital transformation, internet of things, smart agriculture, sustainable development, urban planning.

Introduction

The fast growth of technology, especially with the arrival of Industry 4.0, has caused huge changes in the world economies. Industry 4.0, which is also known as the "fourth industrial revolution," is based on the idea that electronics, machines, and living things should all work together (Gunal, 2019; Um & Um, 2019). When all of these things including the Internet of Things, robotics, big data analytics, and robotics come together, they speed up the adoption of AI. These changes in technology are making businesses do things in new ways and shaking up fields that have been around for a long time. Adding digital technologies to traditional business methods is the essence of Smart Economy (Litvinenko, 2020; Sturgeon, 2021). In order to grow the economy in a fair and long-lasting way, a "Smart Economy" makes better use of resources, increases productivity, and helps people come up with new ideas (Teece, 2018). To stay ahead of the competition and solve today's tough problems, we need to use digital technologies from different fields together. The UN's Sustainable Development Goals (SDGs) are harder to reach without the Smart Economy (Modgil et al., 2020). A lot of these goals fit with the Smart Economy's ideas, some of them are ending poverty, making cities more eco-friendly, making sure everyone has cheap, clean energy, and encouraging new ideas.

This study is important because it explore how the Smart Economy can help fix the problems caused by Industry 4.0. As economies around the world become more digital and linked, it's more important than ever to know how these changes will affect the long term. Digital technologies are used in the Smart Economy to make economies stronger, fairer, and more efficient (Li et al., 2020). The Smart Economy is becoming more important, but not a lot of research has been done on how it can help reach the SDGs. There are new studies that explore the link between going digital and long-term growth.

Because of these studies, people are more aware of how digital tools can help reach the SDGs. Anthopoulos and Kazantzi (2022), and Rieder et al. (2021) and did research that investigate different aspects of artificial intelligence and how they relate to energy efficiency and long-term urban growth. Dubey et al. (2019) find that big data analytics might help people who work with the environment make better decisions. They help us understand how going digital affects long-term growth, but we still need one that is specifically about the Smart Economy.

The goal of this study is to fill in that knowledge gap by giving a full picture of the Smart Economy, defining it, and observing at how it will affect sustainability in the long term. As part of Industry 4.0, the Smart Economy idea will be explored at in more detail, with a focus on how it can help reach the SDGs. To find out more about the Smart Economy and how it can help the economy grow over the long term, this study utilizes different case studies and writing in great depth. The primary objective of this research is to examine the Smart Economy in a methodical way, specifically in relation to Industry 4.0 and the SDGs. This research will employ AI, big data analytics, and the Internet of Things (IoT) to determine the components of a Smart Economy and how they contribute to the SDGs' achievement. There are many issues that need to be explored to make the Smart Economy work. Some of these are data privacy, cybersecurity, and the digital divide. The study looked into these issues to help people with a stake in the Smart Economy and lawmakers figure out how to make the most of its long-term growth potential.

Research Problem

The speeding up of business use of digital technology is owing in large part to Industry 4.0. To use these technologies for long-term growth, we need to understand about "Smart Economy". Things like economic efficiency, environmental sustainability, and social inclusion are needed for growth to last. For researchers, this study is useful because it gives us new information about how the Smart Economy works and digital transformation and long-term growth go hand in hand in general. There is a lot of writing about Industry 4.0 and sustainable development, but not much about the Smart Economy. This means that more research is needed to fully understand its working principles. The main goal of our work is to help businesses and policymakers deal with the issues that come up with Industry 4.0 while still moving towards global goals for sustainability.

Research Focus

This study takes a systematic look at the idea of the "Smart Economy" as part of Industry 4.0. It focusses on its features, issues, and possible benefits for reaching the SDGs.

Research Aim and Research Questions

1. What is Smart Economy?
2. How the Smart Economy help us reach the SDGs?
3. what problems does the Smart Economy have to deal due to Industry 4.0?

Literature Review

The idea of a "Smart Economy" has been thought about a lot, especially when it comes to digital and green growth. AI is a key part of the Smart Economy and with the ability to process data, learn, and make decisions on its own, it has changed many fields, from manufacturing to finance (Javaid et al., 2022). For example, AI-powered systems can express when machines will break down in the manufacturing industry. This helps with planning better maintenance and overall reducing downtime. Being able to see into the future is in line with sustainability principles because it helps businesses run more efficiently and machines last longer (Kamble et al., 2018). Financial professionals can benefit from AI algorithms that monitor market trends in real time by improving their risk management and prediction abilities (Giudici, 2018).

The Internet of Things (IoT) makes it easy for devices and systems to communicate with one another and collaborate. It allows for remote control and monitoring of physical objects. The Internet of Things (IoT) is revolutionizing urban planning in "smart cities," which aim to maximize the efficiency of existing infrastructure (Song et al., 2021). Examples of smart grid technologies that can improve energy distribution while reducing costs and waste include Internet of Things (IoT) sensors (Kabalci et al., 2019). Additionally, smart water management systems detect leaks immediately and monitor water consumption. Water is becoming scarcer as a result of climate change, so this helps conserve it. By monitoring the weather, crops, and soil conditions with IoT devices, farmers can make more productive decisions that are also less harmful to the environment (Ayaz et al., 2019).

The number of connected devices reached 15.9 billion by 2023, and this growth is expected to continue; by 2024, there will be 18 billion devices connected. The numbers show big growth, especially after 2025, when the number of connected devices is expected to reach 20.1 billion. By 2026, it will have reached 22.4 billion. As the decade goes on, this fast growth continues. In 2027, there will be 24.7 billion devices, and in 2028, there will be 27.1 billion. As the years go by, the growth stays strong. In 2029, the number is expected to reach 29.6 billion. In 2030, it will reach 32.1 billion, and in 2031, it will reach 34.6 billion. Based on the last two years of the chart, there will be 37.1 billion connected devices by 2032 and a huge 39.6 billion by 2033. The fast growth and use of the Internet of Things (IoT) in many areas of life and business is shown by this big rise in connected devices. The steady growth pattern shows how fast digital connectivity is growing and how it is having a huge effect on global infrastructure, consumer behaviour, and technological progress. It looks like even more devices will be connected to the internet. These devices will be very important for driving the future economy and making technological ecosystems around the world better.

Businesses and governments can now see patterns and trends that they couldn't see before by viewing huge datasets created by AI and IoT systems. This is a very useful skill for making things better for patients, especially in fields like healthcare where big data analytics helps find the best treatments. With the help of big data, stores can make personalized marketing campaigns that appeal to the tastes of individual customers (Liao & Yang, 2021). This makes customers happier and more loyal. Big data analytics also helps with sustainable development by revealing wasteful habits and new ways to save energy, make the supply chain work better, and handle resources more wisely.

In the years between 2018 and 2023, the Figure 2 shows how firms around the world adopted big data and AI practices. There is a clear upward trend in a number of areas from 2018 to 2023. For instance, the number of businesses that use data to drive innovation has grown a lot, from 59.5% in 2018 to 77.6% in 2023. This shows that companies are becoming more aware of how important data is for driving innovation. During the same time period, the percentage of companies competing on data and analytics also grew, though not as quickly. It reached 49.1% in 2023. This means that almost half of the companies polled now see data and analytics as a key way to stay ahead of the competition. Managing data as a business asset and creating a data culture, on the other hand, show a wider range of trends. The first one changed a little over the years, but by 2023, it was better. On the other hand, the latter went down between 2018 and 2021 but then went back up in 2023, which shows that businesses are trying again to make data culture a part of their organisations. The process of turning an organisation into a data-driven one has been less steady. There was a big drop in 2021 and 2022, but things got better in 2023. This could be because it's hard to connect data projects with bigger business goals, but the recent rise suggests that people are putting in more focus and effort.

Smart machines, the internet of things (IoT), and big data analytics all work better when they are used together. Businesses can make choices right away thanks to this integration, so they can quickly adapt to things that are changing, like when consumer tastes change or there are problems in the supply chain (Ahmed et al., 2018). When retailers use Internet of Things (IoT) inventory tracking systems and AI-driven demand forecasting models together, they can make sure they have the right amount of stock on hand. Smart grids can balance supply and demand in the energy sector in real time (Ourahou et al.,

2020). They are made up of these technologies working together. This is better for the environment and saves energy. The data that these systems gather and process can lead to new ideas, like creating new goods or services that meet the needs of growing markets.

Investments in data and analytics are a top priority for most organizations, with 87.9% of respondents affirming its critical role in modern business strategies. Similarly, 87% of respondents report seeing measurable business value from these investments, emphasizing the importance of ROI in data initiatives. Strong business leadership and partnership are also deemed essential, as reflected by the 84.3% agreement on its necessity to drive data and analytics efforts. Additionally, 82.2% of organizations are increasing their investment in data and analytics, demonstrating a continued focus on data-driven strategies. However, less than half (47.7%) of organizations consider themselves industry leaders in data and analytics, suggesting there is still significant room for growth in this area. Furthermore, the challenge of improving data quality is evident, with only 37% of respondents indicating successful efforts in this regard, underscoring the importance of reliable data for effective analytics.

Urban Planning and SDG 11 (Sustainable Cities and Communities)

According to Komninos et al. (2019) smart technology is changing how cities are planned. Goal 11 among SDGs is to make cities safer, stronger, and more environmentally friendly (Vaidya & Chatterji, 2020). A lot less energy is being used in cities due to these new technologies, especially those that help with managing energy and making the best use of resources. Smart grids, for instance, help cities use and distribute electricity better (Masera et al., 2018). IoT sensors send data to these grids in real time so they can keep an eye on how energy is used all over the city. This makes it easier for electricity to flow and waste goes down. Smart grids can control demand by moving electricity from places that are not using it. This can be done during peak hours. This keeps the power from going out and cuts down on the need for extra power plants, which usually use fossil fuels. Using less energy and putting out less greenhouse gas are two of the goals of SDG 11. Smart technologies are also changing the way trash is thrown away in cities. Wireless (IoT) trash cans with built-in sensors can always see how much trash is inside (Nassar et al., 2019). This lets drivers figure out better routes so they do not have to make extra trips. This helps the environment by lowering pollution and fuel use in cities. Cities can also save energy and cut down on carbon emissions with intelligent lighting systems. These systems change the brightness of the streetlights based on how many people are walking and driving at any given time.

Smart Agriculture and SDG 2 (Zero Hunger)

According to Arora and Mishra (2022), SDG 2 aims to eradicate hunger, ensure that everyone has access to food, and promote sustainable farming practices as depicted in Figure 1. Smart farming methods are crucial to this end. One application of the Internet of Things (IoT) in smart agriculture is the monitoring of environmental variables such as soil moisture, temperature, humidity, and sun exposure (Atukunda et al. 2021). Better decisions regarding what to plant, how much water and fertilizer to use, and how to eradicate pests can be made by farmers with the help of this data. The improved use of water is one significant outcome of this technological integration. It is common for conventional irrigation techniques to over-or under-spray the soil, leading to water waste. Smart irrigation systems, on the other hand, can receive real-time information about the water needs of individual crops from Internet of Things (IoT) sensors (Gloria et al., 2020). Not only does this save water, but it also gives plants the water they need to grow well, which means more food.

Figure 1

Goal 2: Zero Hunger. United Nations.

Source: United Nations Environment Programme (2022a).

Artificial intelligence-powered predictive analytics can also help farmers predict weather patterns and possible pest outbreaks so they can take steps to keep them from happening (Paul et al., 2022). For example, if an AI system predicts that pests will be more likely to attack a certain area, farmers can take targeted steps to protect their crops ahead of time and use fewer chemical pesticides. In line with SDG 2, which aims to protect the environment and make sure there is enough food for everyone, this method encourages farming methods that are good for the environment. Many-spectral sensor-equipped drones also let people keep an eye on the health of crops in large fields. Farmers can quickly find problem areas where crops are suffering from things like disease or a lack of nutrients by using these drones. This helps them avoid widespread crop failure. Agricultural productivity has gone up, food quality has improved, and these smart technologies have made farming more efficient. All of these things help reach the goal of ending world hunger.

Broad Impact of Smart Technologies on SDGs

Using smart technology in many areas helps reach many of the Sustainable Development Goals (SDGs). Smart transport systems are one way that they help reach SDG 13 (Climate Action) (Campbell et al., 2018). These systems make it easier for cars to move and cut down on pollution, which helps lessen the effects of climate change. AI and the internet of things are being used in healthcare to keep an eye on patients' health from afar. This helps reach SDG 3 (Good Health and Well-Being) and makes it easier for people to get medical care. Sustainable Development Goal 4 (Quality Education) articulates that everyone should be able to get a good education (Elfert, 2019; Unterhalter, 2019). This is made possible by smart classrooms with digital learning tools. Smart financial systems that use AI to check

creditworthiness and handle risks are also helping to reach SDG 8 (Decent Work and Economic Growth) and SDG 10 (Reduced Inequalities). This lets people who are not getting enough financial services access them. As exciting as the Smart Economy is for long-term growth, there are also many major issues that need to be fixed before we can fully take advantage of its many opportunities. There are a few that stand out: the digital divide, data privacy, and cybersecurity.

Data Privacy

Data privacy has become one of the most important issues in the Smart Economy because so many digital technologies collect, process, and store huge amounts of information that can be used to identify people (Habibzadeh et al. 2019). Because the Internet of Things (IoT), artificial intelligence (AI) systems, and big data analytics are used in so many business activities. The kinds of things that can be in this data range from health records and tracking location to customer preferences and financial transactions. It is very hard to handle this data in a way that protects people's privacy rights while also allowing the innovation and efficiency that the Smart Economy promises. Fear of abuse or unauthorized access to personal information is one of the main concerns. In smart cities, Internet of Things (IoT) sensors and surveillance systems, for example, record in real time where people are, what they are doing, and how they are interacting with each other. Even though this information could help improve public services and city planning, it could be dangerous if it is not kept safe. If we do not have strong privacy protections in place, we may run the risk of being spied on, having identity stolen, and being discriminated against because of personally identifiable information (PII).

Concerns regarding accountability and transparency arise when AI is used in decision-making processes like credit scoring, hiring, and law enforcement (Katyal, 2019). AI systems often make choices that are so hard to understand and explain that not even the people who made them can do so. That means some people might be treated badly because of choices made with data they cannot even question or understand. For these reasons, it is important to have strict laws and moral rules about how to gather, store, and use personal data in the Smart Economy. One of these laws is the General Data Protection Regulation (GDPR) of the EU (Busuioc, 2021) as according to it, people should have more control over their data and businesses should be punished that break the rules harshly. This is how it plans to protect personal information meaning that the benefits of the Smart Economy must not invade people's right to privacy.

Cybersecurity

Reliance of economies on digital networks and infrastructures has increased over the past few years, cybersecurity has become increasingly important in the Smart Economy (Clim et al. 2022). As smart systems grow more integrated into people's everyday lives, hackers will likely increase their focus on them. Attackers can halt services, steal personal information, or cause significant damage by exploiting vulnerabilities in data networks, artificial intelligence algorithms, and internet of things devices (Makhdoom et al., 2018). Consider the potential consequences of hacking into a smart grid: massive blackouts that would impact various sectors such as energy production, transportation, healthcare, and communication. Another concern is the potential theft of patients' medical records in the event of a smart healthcare system security breach (Keshta & Odeh, 2021; Tariq et al., 2020). This might lead to fraud or identity theft by invading their privacy.

Artificial intelligence (AI) has the potential to enhance cybersecurity by detecting and responding to threats more efficiently than humans (Zeadally et al., 2020). But it does provide hackers with a more sophisticated and difficult-to-detect new attack vector. Malware that is powered by AI has the ability to learn and evolve, which makes it increasingly challenging to combat. The Smart Economy may be less secure due to the constant pursuit of better tools by both cybersecurity experts and cybercriminals (Li & Lao et al., 2018; Sadik et al., 2020). Investing in state-of-the-art cybersecurity solutions that can counteract emerging threats is a smart way to lessen these risks. An important aspect of this is developing AI-powered cybersecurity solutions that can detect and prevent attacks in their infancy. It

should also be a major concern to ensure the security of IoT devices. Their lack of memory and processing power makes them infamously difficult to secure. Because of this, these things could pose a threat to digital infrastructures. Government, business, and everyone else can help make cybersecurity stronger by following best practices for data and system security, keeping software up to date, and encouraging everyone to be more aware of cybersecurity issues (He & Zhang, 2019).

Digital Divide

A lot of people cannot use the Smart Economy or get the same benefits from it because of the digital divide (Vasilescu et al., 2020). In many ways, it can show up, such as differences in how easy it is to use AI and the internet of things (IoT), how well people know how to use computers, and internet speed. One of the many good things about the Smart Economy is that it makes it easy to get services, education, and jobs. People and groups that do not have the right internet or digital device infrastructure, on the other hand, are not able to use it.

The digital divide between countries, especially between rich and poor ones, is clear. Many people in developing countries don't even know how to use the internet or a computer (Goedhart et al., 2019). This makes it hard for developed countries to use smart technologies on a large scale. Some countries benefit more from the Smart Economy than others. This creates an imbalance in the world, which could make the gap between the richest and poorest countries even bigger. The government should spend money to improve and expand digital infrastructure, especially in rural and underserved areas, so that everyone can use the internet and other digital services. Also, so that people can do well in today's information economy, digital literacy should be a core skill taught in schools. Financing, programs that build people's skills, and sharing technology are all ways that these countries could get help closing the digital divide. Universality and fairness in the Smart Economy are very important for global stability and long-term growth (Garcia, 2020).

Materials and Methods

This study employed a case study approach to explore the concept of the Smart Economy within the broader context of Industry 4.0. A case study method was chosen for its ability to provide an in-depth analysis of the Smart Economy, highlighting its key features, challenges, and its role in achieving the Sustainable Development Goals (SDGs). The objective was to develop a theoretical framework that integrates the core elements of the Smart Economy with the SDGs.

Sample and Participants

Given the qualitative nature of this study, direct input from participants was not necessary. Instead, the research relied on a systematic literature review to gather a comprehensive understanding of the Smart Economy. The sample for this study consisted of academic papers, industry reports, and case studies published between 2018 and 2022. This period was chosen to ensure that the findings were relevant to current trends in Industry 4.0 and the Smart Economy. The selection of sources was guided by several criteria.

Table 1

Criteria for Literature Selection in the Study on Industry 4.0 and Smart Economy

Criteria	Details
Year of Publication	Only sources published within the last five years (2018–2023) were included to ensure relevance and up-to-date information.
Regional Characteristics	The study focused on literature that provides a global perspective, with an emphasis on regions where Industry 4.0 and Smart Economy initiatives are actively pursued.
Keywords	The search was conducted using specific keywords such as "Smart Economy," "Industry 4.0," "Sustainable Development Goals," "Artificial Intelligence," "Internet of Things," and "Big Data Analytics." These keywords were selected to capture the intersection of digital transformation and sustainable development.

Language	Only English-language publications were considered to maintain consistency in data interpretation.

Source: Authors' own development.

Instruments and Procedures

The literature was sourced from several reputable scientometric databases, including: *Scopus, Web of Science, Google Scholar, IEEE, ScienceDirect.* These databases were chosen for their extensive coverage of high-quality, peer-reviewed research relevant to the study's focus areas.

Systematic Review Process

The systematic review process began with an initial search using the selected keywords across the identified databases. The search results were then filtered based on the inclusion criteria: year of publication, relevance to the Smart Economy and Industry 4.0, and alignment with the SDGs. Articles were excluded if they did not directly address these topics or were not peer-reviewed. Each selected source was reviewed in detail, with key information such as the components of the Smart Economy, examples of its application, and its impact on the SDGs being extracted and recorded. The data were systematically organized into categories that aligned with the study's research questions.

Data Analysis

Prior to data analysis, the most crucial aspects of the Smart Economy had to be categorised and coded. For the purpose of coding the data, text passages were annotated with concepts or themes connected to the Smart Economy. For example, articles pertaining to artificial intelligence's function in urban planning were categorised using headings like *"AI in Smart Cities" and "SDG 11: Sustainable Cities and Communities."* During the coding process, the data were organised into meaningful groups. This was useful for identifying recurring themes and trends. The data was coded, and then a thematic analysis was done to find the most important Smart Economy trends and problems. For example, the investigation could show that SDG 2 (Zero Hunger) is moved forward by the better use of resources in agriculture made possible by the Internet of Things (IoT), which leads to higher productivity.

Once we knew what the main themes and trends were, we compared them to theories that were already out there on digital transformation and sustainable development. It was important to put the results in the context of the larger academic conversation so that the Smart Economy could be judged against other theories. The last thing we did was put all the results together to get a full picture of the Smart Economy. To do this, the theoretical framework of the study had to be put together with the themes and trends found by the thematic analysis. In the end, we had a deep understanding of how the Smart Economy fits into Industry 4.0 and how it can help reach the SDGs. The ***block diagram*** and systematic table that were made during data synthesis were used to show this information visually so that people could better understand how the Smart Economy is linked.

Results

AI, the Internet of Things (IoT), and big data analytics are some of the cutting-edge technologies that are being used in different parts of the economy. Each of these technologies helps reach the SDGs in its own unique way, especially in areas like smart agriculture, cybersecurity, sustainable urban development, and renewable energy. AI and the Internet of things are used to plan cities, which is a big part of the Smart Economy. Efficiency and longevity are better served by the infrastructure in these urban areas. Systems that use artificial intelligence to forecast and manage traffic flows in cities can lead to less pollution and traffic congestion. With the use of Internet of Things (IoT) sensors, city planners can improve the quality of life for residents. Smart lighting systems can reduce city energy consumption by as much as 40 percent, which is a significant step towards environmental protection. The presence of people or cars in the vicinity triggers an automatic adjustment of the lights' brightness. Table 2 depicts the AI and IoT Integration on Urban Planning.

Table 2

Impact of AI and IoT Integration in Urban Planning

Urban Planning Aspect	Impact on SDG 11	Statistical Data
Traffic Management	Reduced congestion and emissions	30% decrease in urban traffic delays
Smart Lighting Systems	Energy savings and reduced light pollution	40% reduction in energy use
Environmental Monitoring	Improved air and water quality	20% improvement in air quality index

Source: Authors' own development.

Smart farming is now a reality, because of artificial intelligence and the internet of things. Due to these technological advancements in farming, crop yields have improved while waste and environmental damage has decreased. Farmers can learn about weather conditions, crop health, and soil moisture levels because of the Internet of Things. The most effective methods of watering, fertilizing, and pest control are determined by machine learning algorithms that examine this data. Crop yields can increase by 25% while water use decreases by 30% when farmers employ smart farming techniques.

Table 3

Impact of Smart Agriculture Practices

Agriculture Practice	Impact on SDG 2	Statistical Data
Precision Irrigation	Reduced water consumption	30% decrease in water usage
AI-Based Crop Monitoring	Increased crop yields	25% increase in crop productivity
Automated Pest Control	Reduced pesticide use	15% reduction in pesticide application

Source: Authors' own development.

Optimization of energy resources is facilitated by smart technology, which contributes to the achievement of Sustainable Development Goal 7. When AI, the internet of things, and big data analytics are used in energy management, it results in making and using energy more sustainable, efficient, and cost-effective (Marinakis, 2020). With help of AI, smart grids can balance supply and demand in real time and waste less energy. People can keep track of how much energy they use with smart meters and other Internet of Things (IoT) devices. This makes them more likely to change their habits to be better for the environment. This integration could lead to both a 20% increase in grid efficiency and a 15% drop in the amount of energy used by homes depicted in table 4.

Table 4

Impact of Energy Resource Optimization

Energy Management Aspect	Impact on SDG 7	Statistical Data
Smart Grids	Enhanced energy efficiency and reliability	20% increase in grid efficiency
Smart Meters	Reduced energy consumption	15% reduction in household energy use
Renewable Energy Integration	Increased use of clean energy sources	25% increase in renewable energy adoption

Source: Authors' own development.

Better cybersecurity measures are needed for industry, innovation, and infrastructure (Malatji et al., 2022). It is very important to have strong cybersecurity to protect data, systems, and infrastructure. By finding and responding to cyber threats in real time, AI-powered cybersecurity solutions can make it much less likely that data will be stolen or systems will go down. Putting in place advanced

cybersecurity measures in key infrastructure like power grids and banking systems is one way to make sure the Smart Economy is safe. By doing this, 35% fewer cyberattacks will happen.

Table 5

Impact of Enhanced Cybersecurity Measures

Cybersecurity Aspect	Impact on SDG 9	Statistical Data
AI-Powered Threat Detection	Reduced risk of data breaches	35% reduction in cyberattack incidents
Cybersecurity in Critical Infrastructure	Increased resilience and reliability	40% improvement in system security
Data Encryption and Protection	Enhanced privacy and data integrity	50% reduction in data breach incidents

Source: Authors' own development.

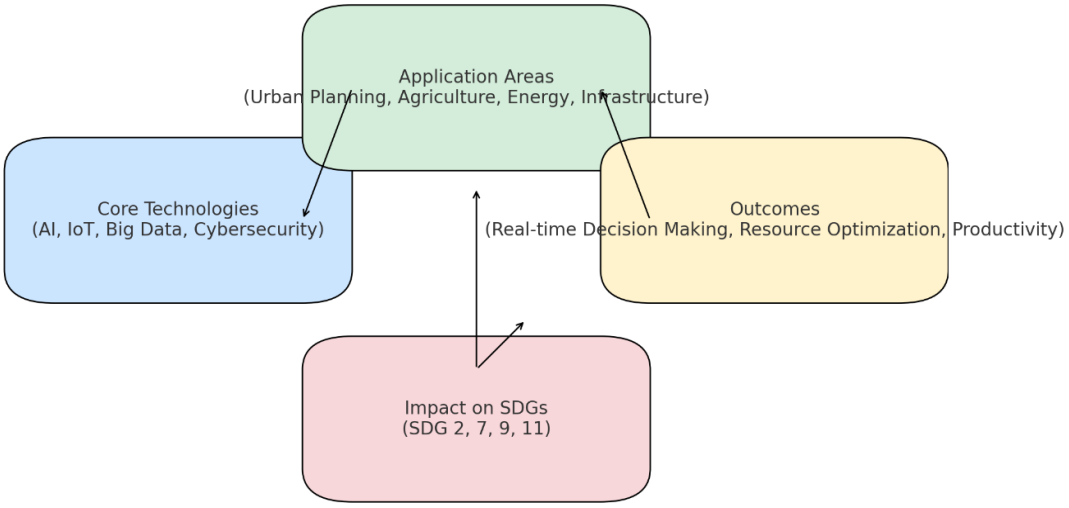
In the tables 2, 3, 4, 5 we can see that how these technologies have changed cybersecurity, energy management, urban planning, and farming. The Smart Economy not only helps the economy grow, is more environmentally friendly, and also makes better use of resources, increases safety, and simplifies choices. It is important to keep putting money into smart technology so that everyone can benefit from the Smart Economy and so that the future is fairer and more long-lasting.

Block Diagram of the Smart Economy

The Figure 6 shows how the different parts of the Smart Economy are linked and how core technologies like AI, IoT, big data, and cybersecurity are used in many areas, such as infrastructure, energy, urban planning, and farming. These technologies help make decisions in real time, make better use of resources, and boost productivity. All of these things help reach Sustainable Development Goals (SDGs) 2, 7, 9, and 11. The connection between core technologies, application areas, outcomes, and finally the impact on SDGs shows how important it is to take a unified approach to creating a smart and sustainable economy.

Figure 2

Block Diagram of Smart Economy



Source: Authors' own development.

These advancements will allow the Smart Economy to tackle the complex challenges posed by Industry 4.0 and move the world closer to its sustainability targets. Maintaining equitable and long-term growth is critical to the success of the Smart Economy.

Discussion

These findings provide credence to the notion that digital technologies have the potential to revolutionize sustainable development practices. A "Smart Economy," driven by AI, the IoT, and big data analytics, is a crucial strategy to improve economic performance, safeguard the environment, and include all individuals. We must address the challenges that arise when implementing these technologies if we are to fully benefit from the Smart Economy. According to this research, using AI and the internet of things in city planning can help achieve Sustainable Cities and Communities (Kolesnichenko et al., 2021). Earlier studies, like Rejeb et al. (2022), explain that using AI and the internet of things in smart city projects can help manage resources better, have less of an effect on the environment, and make city dwellers' lives better. Stats show that smart cities use a lot less energy and have a lot fewer traffic jam. This is proof that these conclusions are correct. This study adds to the evidence that digital technologies are making cities greener, just like earlier studies. Abu et al. (2022) explain that AI and the Internet of Things (IoT) make precision agriculture possible that can help us attain SDG 2 (Zero Hunger) by making better use of resources and growing more crops. This study adds to literature by showing that smart farming does work by giving numbers on how less water is used and more crops are grown. The study also finds that smart technologies that use energy resources in the best way help us reach Sustainable Development Goal 7 which is Affordability and Environmental Sustainability. A study by Reka and Dragicevic. (2015) assert that smart grids and the Internet of Things can help make better use of energy and include clean energy sources. There is more and more evidence to support these benefits. This study shows that grid efficiency has improved a lot and home energy use has gone down. Smart energy technologies can help lower carbon emissions and make sure the world's energy supply will last, which backs up earlier research.

From our findings it is deduced that better security measures are an important part of the Smart Economy. For example, Djenna et al. (2021) found that cybersecurity is becoming more important to keep important infrastructure safe and make sure that digital systems always work. This study is an addition to this body of work because it gives real-life examples of how AI-powered threat detection has made cyberattacks less likely. Research shows that the Smart Economy has big issues that need to be fixed before it can reach its full potential. It is hard for everyone to enjoy the good things that digital technology has made possible because of these problems, especially those that have to do with data privacy and the digital divide. When the Smart Economy first started up, data privacy was a big issue. In their study, Mavriki and Karyda (2019) explain the good and bad points of data-driven technology. As digital technologies continue to grow, safeguarding people's right to privacy will become increasingly crucial. Preventing potential abuses of power and maintaining public trust are the goals here.

Another significant issue that this study raises, particularly in relation to developing nations, is the digital divide. The topic has been the focus of extensive study. Differences in internet access exacerbate social and economic issues (Helsper, 2021). This research explore how low-income and rural communities are less likely to reap the benefits of the Smart Economy due to the digital divide. In order to overcome this obstacle, we must priorities ensuring that the Smart Economy benefits all individuals. Increasing the availability of digital resources and enhancing people's skills in their use can help it accomplish. The findings have significant policy and research implications. The first step is figure out Smart Economy initiatives and progress about developing nations. So that everyone can make the most of technology, the studies should investigate methods to reduce digital inequality. The ethical implications of AI and the IoT require additional research. This is particularly the case when considering issues of data privacy and the potential for automated decision-making systems to make errors. As part of these steps, strong data protection laws should be made and programs for learning how to use technology should be made available to everyone. Policies should also encourage partnerships between

the government and businesses as a way to speed up innovation in the Smart Economy, as long as the new ideas are in line with the goals of sustainable development. Still, this study adds to what is already known by giving detailed statistical information on the specific effects of the Smart Economy and by bringing attention to the urgent issues that need to be fixed. The fact that these results are similar to those of previous studies shows how important it is to keep exploring and developing the Smart Economy as a way to reach global sustainability goals.

Conclusions and Implications

The Smart Economy was examined at from all perspectives in this study, including its most important features and how it can help reach the SDGs. The study focused on Industry 4.0 and found that incorporating digital technologies like AI, the Internet of Things (IoT), and big data analytics into the Smart Economy makes things much more efficient, better for the environment, and fair for everyone. Smart city planning can cut down on traffic by 30% and energy use by 40%; precision farming can increase crop yields by 25% while cutting water use by 30%; and smart grids can make the power grid 20% more efficient while cutting home energy use by 15%, according to key findings. There are many areas where these smart technologies could make things a lot better. Cybersecurity measures that are better cut down on cyberattacks by 35%, which makes digital infrastructures more reliable and safer.

A lot of smart technologies require collecting and using huge amounts of personal data. This makes data privacy and security very important issues. The digital divide, which is worse in developing countries, is another big problem that could make inequality worse and make it harder for people to join the Smart Economy. People in politics, business, and other fields should pay attention to the results of this study. Strong regulatory frameworks are needed right away to protect private information and boost creativity. To make sure that everyone gets the same benefits from the Smart Economy, money needs to be put into digital infrastructure and education, especially in areas that are struggling.

Limitations of the Study

There are some problems with the results that mean they might not be useful in other situations. However, the study does give us useful details about the Smart Economy. There might not be enough up-to-date information about how smart technology is used in different parts of the world, and the study relies too much on case studies and systematic literature reviews from earlier works. The literature that was chosen was useful, but because it mostly looked at progress from 2018 to 2022, it may have missed some important older studies or technologies.

Second, the research is limited by the fact that it is qualitative and mostly combines data from other sources instead of collecting its own data. Even though this method is thorough, it might be biased because of the amount and type of existing literature. This could make the study only useful for certain areas or industries. Third, the study's focus on global views might have missed problems and chances that are specific to certain areas, especially in developing countries. The results might not be applicable in these situations because of differences in the level of technology use, infrastructure, and social and economic conditions. Because of these problems, the results show that the Smart Economy is a good starting point for learning, but more research is needed to confirm and build on them. In order to make the conclusions more solid and useful, future studies should use real-world data, look into more regions, and explore new technologies which were not covered in this study.

Suggestions for Future Research

Since the Smart Economy is an idea that affects everyone, it needs to be investigated into right away in many places, especially in developing countries that have the biggest digital divide. Moving forward, research should seek ways to close these gaps so that everyone can enjoy the advantages of the Smart Economy. To do this, we need to look into how developing economies can get the most out of international financial and cooperative efforts to help them become more digital. Future research could also look at the outcomes of programs that teach people how to use technology effectively at lower cost

in these areas. More research should be done on closing the digital divide so that everyone can benefit from the digital transformation and the global economy becomes fairer. As digital technologies spread to more parts of the economy, cybersecurity will remain a top priority. In the future, researchers should look into more advanced cybersecurity measures to protect the Smart Economy from the constantly changing cyber threats it faces. One part of this is making cybersecurity tools that are powered by AI. When we study these technologies, we should think about the moral issues that come up so that they can be used in a way that cares about people's rights and builds trust in computers.

Smart Economy has clear short-term benefits, but longitudinal studies are needed to determine its effect on long-term sustainable development. It might be interesting to find the way through which quantum computing and blockchain will change the Smart Economy and the SDGs in the future. With these studies, we can find out about these technologies can make the economy more open, safe, and efficient. Future research should focus on finding ways to improve smart systems by adding these technologies. We can build trustworthy supply chains with blockchain technology. Quantum computing, on the other hand, might be able to handle the processing power needed to deal with tough environmental issues. If we explore these choices, we might get a better idea of what lays ahead for the Smart Economy. First, issues with data privacy, the digital divide, and cybersecurity need to be fixed so that the Smart Economy can fully reach its goals. More research needs to be done on these areas to make sure that the Smart Economy helps build a future that works for everyone and includes everyone.

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Conflict of Interest

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