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The Impact of Modern Research and Innovation on Society and Individuals

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ABSTRACT

Life quality and socio-economic conditions have improved dramatically over the last century due to the rapid advancement and innovation of modern technologies, which have evolved from the fruitful research of scientists. It will continue to grow throughout the twenty-first century and beyond and reach every corner of the globe without ambiguities. Scientists research and innovate ideas, technology, and tools for enhancing life quality, productivity, economy, and environment. However, inappropriate implementation, strategy, and design could drive society and individuals backwards. Recently, humans have encountered severe and periodic natural catastrophes, such as intense hot and cold climates, deluges, tsunamis, typhoons, landslides, droughts, wildfires, pandemics, etc., as well as nation- and society-driven riots, wars, espionage, and social phobia, where modern tools and innovations employed. It severely affects the mental health and socio-economic conditions of individuals and society due to the damage to infrastructure, shelter, agricultural land, deaths of humans, animals, and livestock, and environmental pollution. Besides, detrimental events are caused by environmental pollution and global warming and are triggered by human activities and abusing of modern innovations and science. This study qualitatively explores the most influential impacts of contemporary research and innovation in different fields on society and individuals by investigating the recent relevant research and events. It is revealed that modern innovations and technology have severe detrimental impacts on society and individuals if they are abused and executed recklessly. This study will aid in reducing and understanding the harmful effects of research and innovation on society, ultimately enhancing social health and progress.

1. INTRODUCTION

The breakthrough discoveries and advancements in different fields and their impact on individual and social life throughout the last century are indisputable. In contrast, climate change, global warming, population growth, rising sea levels, melting Arctic ice, carbon emissions, environmental pollution, avalanches, and war have become significant concerns for the world and scientists. Human activities, inappropriate implementation, and abuse of modern innovations and tools play substantial roles in global warming, environmental pollution, climate change, and deterring social attributes. Though scientists research and innovate new technology, ideas, and products to enhance life quality and social conditions, inappropriate implementation, strategy, design, and excessive and unethical use could roll individuals and society backwards. Recently, people have been facing nation- and society-driven detrimental events, such as riots, wars, espionage, and social phobia, where modern tools and innovations are employed. It severely affects the mental health and socio-economic conditions of individuals and society due to the damage to infrastructure, shelter, and agricultural land; the deaths of humans, animals, and livestock; and environmental pollution. Besides, detrimental events are caused by environmental pollution and global warming, triggered by human activities and abuse of modern innovations.

This study aims to explore the societal impact of modern research and innovations in different fields by investigating contemporary and relevant scientific studies and events. The societal effects of current innovation in the medical field, unmanned vehicles (UVs), hybrid and electric vehicles, energy, electronics, the internet, social media, war, space exploration, underwater and tall structures, robotics, artificial intelligence (AI), automation, waste control, and the

development of green material are studied qualitatively. It is revealed that besides the positive impact, modern innovations and technology have severe detrimental effects on society and individuals if abused and executed recklessly. Besides, it sparks the deterioration of the individuals and social conditions if they are not aware of it.

Some studies have reported the impact of contemporary discovery and technology in a particular field on society. Ayala (2015) and Häyry (2018) explored the ethical, biological, and social considerations of human cloning. Bartolo & Mantovani (2022) studied the ongoing and future research and trends of bioartificial organs. They expect to improve the quality of human life and preservation through bioartificial organs. However, its negative impact on society and individuals was not explored in their study.

Yaqot & Menezes (2022) and Rao et al. (2016) studied the social effects of unmanned aerial vehicles (UAVs) and the risks of commercial drones. Sheikh et al. (2016), Chilán (2018), and Kumar (2020) explored the social, economic, and environmental impact of renewable and sustainable energy. Commerfond (2011) studied the ecological and social impact of hydroelectricity. Yet, the effect of the failure of built-in algorithms and codes used in the ground and aerial UVs, recycling of batteries, and effect on marine life and birds flying paths are not thoroughly discussed in those studies. Huhtala & Remes (2017), Denning & Mubayi (2017), and Bazile (2012) investigated the social risk, costs, and impact of nuclear energy. However, their study does not discuss the effect of inappropriate plans, strategies, and designs; inadequate safety measures; and failure to remove and minimize uncertainty.

Kim et al. (2016), Nath & Mukherjee (2015), Sarwar & Soomro (2013), and Carbonell et al. (2013) studied the social impact of smartphones and cell phones. However, the effects of social media, instant messaging, the internet, and addiction to dark sites are not discussed in their study. In addition, the impact of remotely activated explosives on personal electronic devices is not explored. Bun et al. (2024) studied greenhouse gas emissions from the Ukraine and Russia wars. However, the effect of war on society and individuals is not explored. Justino (2022) and Modell & Haggerty (1991) investigated poverty, war, and the social impact of war. Yet, war's impact on democracy, human rights, women and children, leadership, and psychological effects on society are not discussed in their study.

Corrado et al. (2023), Miraux (2022), Kalam (2008), and Vedda (2008) investigated the future of space exploration, economic growth, environmental limits, and the sustainability of space exploration. However, the social needs of space exploration and the long-term effects of ozone layer destruction on global life and pollution have not been revealed. Song et al. (2020) investigated the noise radiation from the underwater tunnel. Yet, their study does not mention the impact on marine life migration paths, the leakage and sabotage of underwater gas and oil pipelines, and the consequences of sinking vessels and submarines. Giyasov & Giyasova (2018) and Ghazaleheniya & Özsavaş (2022) studied the impact of high-rise buildings on the environment. However, the effects on children due to the lack of playgrounds and the impact of transport networks, traffic congestion, waste and sewerage control, rescue missions, and emergency evacuation have not been explored.

Clark (2023) investigated the valorization of waste at the molecular level to develop exploitable polymers. However, its social effect is not revealed in his study. Mobarak et al. (2022) recycled COVID-19 waste face masks into polyester composites. Yet, its social effects are not explored in their research. Qian et al. (2024) studied societal impacts of AI. Choi & Kim (2023) investigated integrating AI into financial instruments. However, the negative aspects of AI on society, the jobs market, and individuals are not highlighted in their study.

The studies mentioned above are focused on innovation and research in a particular field, and its effect on society and individuals is explored limitedly. Besides, they are not intended to make people aware of the negative impact of modern research and innovation. Therefore, exploring the detrimental effects of contemporary discovery science and technology in various fields on society and individuals is demanded. This study collectively and qualitatively explores the social impacts due to the rapid advancement of modern research and innovations. It will facilitate the reduction and understanding of the harmful effects of modern technology, tools, research, and innovations on society and raise awareness.

2. METHODOLOGY

The societal impact of modern research and innovation in different fields, such as medical fields; unmanned ground, water, and aerial vehicles; renewable, hydro-electro, and nuclear energy; electronics, the internet, and social media; war machines and explosives; space exploration; underwater and tall structures; waste control and green materials; robotics, artificial intelligence (AI), and automation, is investigated. The most influential impacts of modern research and innovation in different fields on society and individuals are reported qualitatively by investigating contemporary and relevant discoveries, research, and events. Their influences, advantages, and detrimental effects on individuals and society are explored to grow awareness among individuals, society, and researchers. The social, economic, ethical, unemployment, education, circular economy, ecology, sustainability, regional safety and security, human rights and trafficking, crimes, conflict between different social layers, and environmental attributes are considered core impact domains to be revealed by investigating contemporary and relevant scientific studies, which is shown with a flow chart in Figure. 1.

2.1 Medical Field

There have been remarkable discoveries in the last 50 years in the medical field, such as antibiotics, vaccination, CT and MRI, TB therapy, angioplasty, randomized controlled trials, HIV anti-viral therapy, cholesterol drugs, kidney dialysis,

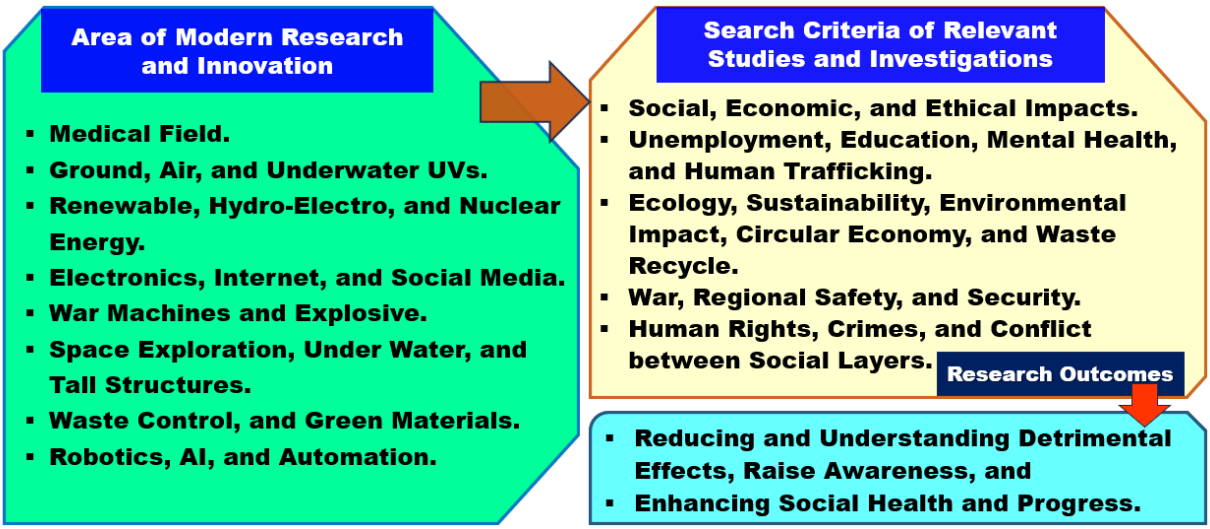

Figure 1: Flow chart of selecting contemporary studies and investigations.

angiotensin-converting enzyme (ACE) inhibitors, endoscopy and laparoscopy, stomach ulcer treatment, organ transplant, analgesic ladder, erythropoietin, aspirin, and contraceptive pills (Mishra, 2016; RCPE, 2010). Therefore, life expectancy increased by 61.13% from 1950 to 73.33 years in 2024 and is expected to be 81.88 years in 2100 (Macrotends, 2024). Recent research on patient treatment, care, detection, monitoring, diagnosis, and management moves life expectancy and social quality further. Besides, human and animal cloning, test tube babies, the implementation of BioMEMS, MEMS, and NEMS, genetic engineering, regenerative cell and tissue therapy, CAR T-cell treatment, COVID-19 mRNA shots, telemedicine, etc. are modern innovations in the medical field (James et al., 2008; Mahara et al., 2023; Rahman & Salam Akanda, 2022). The development of implantable artificial human organs, such as eyes, heart, muscle, liver, skin, and brain; wearable artificial kidneys (WAK); total artificial hearts (TAH); 3D printing of skin and tissues; polymeric nanofibers, rods, and tubes; and bio-artificial organs and tissues, are underway to treat human life (Bartolo & Mantovani, 2022; Mahara et al., 2023; Maynes et al., 2020). It will enhance the individual's life and social attributes further, without any doubt. However, inappropriate and unethical use of innovation leads to social crimes, abuse, murders, and human trafficking for stealing organs, which leads to violations of human rights and risks to individual and public health (Domínguez-gil et al., 2017). Cloning and genetic engineering improve livestock and farm production; however, cloning with somatic cell nuclear transfer (SCNT) technology can develop an adult individual with duplicate attributes and mirror images (Ayala, 2015; Häyry, 2018). Conversely, it is unethical and inhuman and could lead to the development of humans with evil characters (Häyry, 2018). It will confuse society and individuals with identity problems, visual hallucinations, illusions, and psychological conundrums. It can be used by criminals, gangs, special groups, and even a state agent to drive out individuals and ethnic groups from a society, region, or vague nation. It will be detrimental to society, individuals, and human rights if it is not guided by ethics, laws, and policies.

2.2 Ground, Air, and Underwater Unmanned Vehicle

Due to the development of lightweight materials, micro- and nano-scaled sensors and objects, the high computation power of microchips and artificial intelligence (AI), unmanned ground vehicles (UGV), aerial vehicles (UAV), underwater vehicles (UUV), electric vehicles, and hybrid vehicles have become remarkable innovations. They are gaining popularity and are employed in different fields with confidence because of their easy accessibility, remote controllability, maneuverability, and payload-carrying ability (Hu & Assaad, 2023). UUVs and UAVs are used in transport, communication, surveillance, rescue missions, fire detection, traffic monitoring, border patrol, agriculture, forestry, and warfare (Muchiri & Kimathi, 2016; Stojnić et al., 2021). UGVs are gaining popularity for business and personal transport. They are operated and function based on AI systems and optical scanning. Those innovations push individual, national, and social attributes forward with assurance, and their application is increasing rapidly. Besides developing hybrid and electric vehicles, super- and hypersonic aerial vehicles, missiles, and launching systems also contribute to changing social and national characteristics, the global environment and deterring external threats. Recent discoveries of solid-state, lithium, and sodium-ion batteries will help grow the use of electric and hybrid vehicles. Besides the positive impacts of unmanned aerial vehicles (UAVs), they can be used to spy on personal properties and individual rights if handed to the wrong person or group since they are built with data collection, imaging, and mapping capabilities (Rao et al., 2016). High skills and knowledge are required to design, fabricate, and maintain unmanned vehicles (UVs). Therefore, a class of individuals and a layer of society will need to catch up with the progressive one due to a lack of know-how and comprehension (Yaqot & Menezes, 2022). Lot of people will lose their jobs if unmanned ground vehicles (UGVs) are implemented aggressively in every stage of business and society. Social conditions within the layers of society will differ significantly, leading to social imbalance and conflict. In addition, ecological issues may

arise due to the development of micro-air vehicles, such as robotic flying birds, insects, bees, etc. (Folkertsma et al., 2017; Wood, 2008), which may distract birds and instigate changing their flying paths and natural habitats (Bech-Hansen et al., 2020; Vas et al., 2015). Similarly, marine life may distract, scare, and change inhabitants and moving paths due to unmanned underwater vehicles (UUVs). Life and property may be damaged if the unmanned ground vehicle (UGV) fails to respond with the on-time real-world facts on the road since they are designed to process the scenarios through numerous artificial neurons, which only function based on the built-in algorithms and codes and are not flexible enough to judge like human intuition and brains. In addition, outsiders can take control if it is not built with enough security features. Lithium- and sodium-ion battery-based hybrid and electric vehicles are flourishing to boost air quality and reduce pollution. However, the lack of recycling of batteries could lead to environmental hazards and severely impact social life.

2.3 Renewable, Hydro-Electro, and Nuclear Energy

Energy is crucial for individuals, society, and nations to have a worthy and progressive lifestyle. Its demand increases intensely due to population growth and industrial development (Bayazit, 2021; Commerfond, 2011), as projected world energy demand will increase to 35% by 2035 (Commerfond, 2011). It is the most crucial sector responsible for CO_2 emissions and global warming. The global CO_2 emissions from energy combustion and industrial processes and the annual change are shown in Figure. 2. It has increased sharply from 1980 to 2022 and will continue to grow. In 2022, global CO_2 emissions from energy combustion and industrial processes were 36.8 Gt, and 14.5 Gt were generated from the power sector (IEA, 2023).

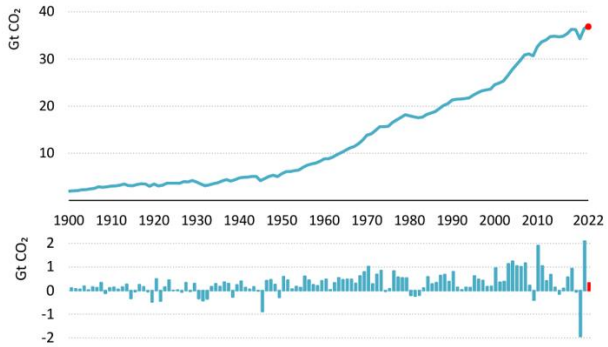

Figure 2: Global CO_2 emissions from energy combustion and industrial processes and their annual change, 1900-2022 (IEA, 2023).

Due to global warming and environmental pollution, fossil fuel use is deterred in most countries (Bayazit, 2021; Kumar, 2020). They are switching to renewable energy, such as hydropower, wind, solar, biomass, ocean energy, biofuel, geothermal, etc., which is inexhaustible, clean, and sustainable and meets 15–20% of world energy demand (Chilán et al., 2018; Kumar, 2020). Despite the global CO_2 emission increases from coal and oil and decreases from natural gas in 2022, as shown in Figure 3, it severely impacts the environment and social life.

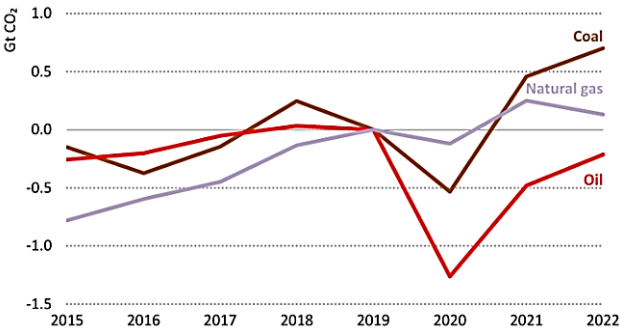

Figure 3: Comparative change in global CO_2 emissions by fuel, relative to 2019 (IEA, 2023).

Therefore, hydropower, wind, solar, and ocean energy have become popular, significantly impacting social life, national stability, security, and attributes (Sheikh et al., 2016) since they have the lowest operating costs and high efficiency (Chilán et al., 2018). Hydropower has the lowest emissions and creates jobs and tourism. However, improper design, planning, location, and maintenance could lead to sudden catastrophes, such as localized flash floods, destroying agricultural lands, unbalanced ecological systems, changes in fishing life, and the depletion of Indigenous resources (Chilán et al., 2018; Sheikh et al., 2016; Sternberg, 2008). Similarly, poorly planned and executed wind and solar energy could distract the birds' flying paths and their inhabitants, ultimately affecting the ecology and social life. The disposal of waste solar panels is also a critical issue (Xu et al., 2018) and poses environmental threats if appropriate recycling methods and disposal policies are not implemented (Tammaro et al., 2016). Nuclear energy is popular due to its cleanliness, low operative cost, high plant life, and efficiency (Bazile, 2012; Huhtala & Remes, 2017). However, safety measures and civil liability costs are higher than other energy sources (Huhtala & Remes, 2017). High public health risks are due to radioactive leakage, dismantling, accidents, and radioactive waste hazards. The social and environmental consequences, such as the Chernobyl accident in 1986, Three Mile Island in 1979, and Fukushima in 2011 (Denning & Mubayi, 2017), are severe and detrimental. Though all advancements in the energy sector are achieved through the successful research of scientists and intended for positive social impact and life quality, inappropriate plans, strategies, inadequate safety measures, and failure to remove or minimize uncertainty and risk could affect social life and the environment severely for a long time, generation after generation.

2.4 Electronics, Internet, and Social Media

The innovation of small electronics, spying, surveillance equipment, computing devices, cell phones, smart watches, PlayStations, wireless networks and cameras, WiFi and the internet, social media, and instant messaging has intensely influenced individuals and social life dynamics. Individual lifestyle and quality, social characteristics, and national attributes are boosted due to cell phones, smartwatches, the internet, wireless cameras, social media, and instant text and video messaging (Sarwar & Soomro, 2013). It helps to improve business, social services, health and education, recreation and entertainment, social bonding and connectivity, and the scope of gathering and spreading

information and news instantly within a moment and at your fingertips (Kim et al., 2016; Nath & Mukherjee, 2015). It has a tremendous positive impact on society and nations by creating jobs, confidence in security, and social connectivity (Sarwar & Soomro, 2013). Due to instant text and video messaging, social media, and connectivity, people are engulfed with real-time news and information and exchange views and ideas instantly around the world. It helps people, society, and even a nation judges the integrity and authenticity of the mainstream media and develop a sense of judgment and demand to establish human rights. It tremendously influences society and the entire globe. However, those innovations could be used by individuals, groups, criminal gangs, unique casts, and even nations to spread rumors, false news, and messages; spy and conduct surveillance on individuals and society; and hack phones and electronic equipment, including TVs, radios, UVs, etc. Besides, it is possible to use remotely activated explosives in personal electronic devices, such as walkie-talkies, pagers, and even cell phones, which has already been proven by the recent conflict in the Middle East (Helou et al., 2024). Furthermore, it leads to breaches of privacy, hacking of healthcare data (Newaz et al., 2021), cybercrime and bullying, identity theft, violating human rights, the law, and the constitution, and spreading crime and violence within the different ethnic groups and colors of society. It could even be used against individuals, groups, or ethnic groups to dislocate or remove them from a locality and a job by creating an artificial psychological sting and hostile environment, violating individual privacy and dignity (Santanen, 2019) by exposing personal life, bullying, and threatening. Also, it could be used for human trafficking and exploiting children, girls, and women. In addition, excessive and inappropriate use of electronic equipment, social media, video games, and the internet could lead to addiction (Carbonell et al., 2013), exposure to pornography, distraction from everyday life and study, and instigating social crime, mass shootings, and disorders. Besides, health issues such as sleep disorders, headaches, brain cancer and tumors, anxiety, Alzheimer's and Parkinson's, dizziness, and vision problems can be raised due to the exposure to electromagnetic radiation from the extended use of cellphones, tabs, video games, etc. (Carbonell et al., 2013; Kim et al., 2016). It also leads to the isolation and disconnect of individuals from family and society, and they fail to interact appropriately in academic, business, and professional life. Ultimately, it turns society and the nation backwards. Though scientists have innovated those things to improve quality of life, improper, unethical, excessive, and indulgent use of cell phones, tablets, and other mobile devices is harmful to society if not controlled and regulated appropriately by ethics and moral values.

2.5 War Machines and Explosive

The researcher developed war machines, tools, and explosives to achieve national security and deter external threats. However, authoritarian, corrupt, culpable, and vulnerable leaders promote war between nations and societies (Modell & Haggerty, 1991). Sometimes, they instigate riots and civil wars within the different layers of society (Justino, 2012). War causes population dislocation, damages infrastructure, institutions, the economy, and law and order, and changes the boundaries and attributes of a nation (Modell & Haggerty, 1991). It affects livelihoods, economic survival, and security and promotes poverty, institutional dysfunction, and social networks (Justino, 2012). Therefore, different non-state actors, such as rebel groups, militias, paramilitaries, warlords, gangs, mafias, and drug traffickers, overplay the general population, women, and children (Justino, 2012). It stimulates deep agitation and turmoil and intensifies the civil war. Conducting war is highly costly in terms of human life, economic and psychological trauma, malnutrition, post-traumatic stress disorder (PTSD), and antisocial personality disorder (ASPD) within individuals and society (Mandalakas, 2001; Modell & Haggerty, 1991). Besides, tons of carbon emissions into the atmosphere due to the deployment of war machines and tools and the detonation of explosives lead to global pollution and silently impact all nations and societies. In the Russia and Ukraine wars, 77 Mt CO_2 were released into the atmosphere within the first 18 months of the war (Bun et al., 2024), and 281,000 metric tons within the first 60 days of the Gaza and Israel wars, as per US and UK-based researchers (Lakhani, 2024). War resources are invented through successful research to improve national and social security. However, it is being misused without considering its impacts on society, the global environment, the economy, and human life. War tools may be misused without justification if handed to the wrong groups or corrupt, authoritarian, and unstable leaders. Sometimes, a lack of democracy, human rights, failed institutions and legal systems, corruption, guilt, vulnerability, and a lack of cognitive judgment of a state or leader can initiate war and turmoil within society to hold and increase tenure (Croco & Weeks, 2016).

2.6 Space Exploration, Underwater and Tall Structures

Space exploration enhances the economy and quality of life by creating jobs and advancements in education, technology, and research (Doyle, 1989; Shaghaghi & Antonakopoulos, 2012). It provides enthusiasm, scholarly inspiration, and spiritual fulfillment for a nation and scientists (Vedda, 2008). Space technology and satellite systems are used to explore the universe and planets, use telecommunication and global positioning systems (GPS), and monitor armed conflict, weather patterns, natural disasters, and asteroid collisions (Corrado et al., 2023; Kalam, 2008). The vision of space exploration includes planet and asteroid mining, moon-based telecommunication and planet communication hubs, space-based solar power (SSP), tourism, etc. (Kalam, 2008; Miraux, 2022). Though space exploration improves the life quality of a particular layer of society, sometimes it could be a man-made disaster (Vedda, 2008), such as Columbia (2003), Challenger (1986), Apollo 12 (1969), Soyuz-11, etc., and emits 40,000 tons of materials to the atmosphere each year, greenhouse gases from space shuttle and rocket launches, destroying stratospheric ozone layers, and producing space debris (Miraux, 2022), which impacts global climate. Besides, the cost-economic benefit of space exploration needs to be justified and prioritized based on other social needs. In the long term, it will reduce the overall quality of global life

since it provides environmental pollution and damages the ozone layer.

Underwater structures, such as tunnels, pipelines, cable lines, offshore structures, water vessels, submarines, etc., are built to ease the cost of rapid transport and the hardship of human life. However, if they are not planned and designed with reliability by removing uncertainty during design and planning, they may harm marine life, aquatic fauna, and the ecosystem by transmitting stress and shock waves, noise, vibration, and underwater acoustic pressure during traffic flow through tunnels (Dugan et al., 2011; Jiang et al., 2023; Song et al., 2020). As a result, marine inhabitants and migration paths can be affected by underwater structures. Besides releasing metal and plastic particles, paints, acids, chemicals, and plastics into the water from floating and sinking vessels, submarines, underwater oil and gas pipeline leakages, and failure of undersea lines because of sabotage, such as blowing up the Russia-Europe Nord Stream gas line (Bogdan & Radosław, 2022; Díaz-Secades, 2024; Ratnayake, 2023). The environmental impact of underwater structures cannot be ignored and needs to be investigated before implementation.

Housing is a basic human need and affects socio-psychological factors, social ramifications, and homelessness (Bose et al., 2023). Due to population growth and migration to the metropolitan area, vertical living has become the most attractive amenity for individuals and society (Ghazaleheniya & Özsavaş Akçay, 2022). It reflects uniqueness, aesthetics, special heritages of individuals, and living dynamics (Ghazaleheniya & Özsavaş Akçay, 2022). Though it improves the quality of life to some extent, it has negative societal impacts, such as visibility and side effects, if not designed and planned appropriately; it interrupts social and cultural continuity and degrades cohesiveness (Ghazaleheniya & Özsavaş Akçay, 2022). Moreover, the vertical village and tall buildings negatively affect the environment by obstructing natural wind flow, blocking sunlight and visibility, creating air turbulence, obstructing bird flying and migration paths, and increasing adjacent air temperature (Giyasov & Giyasova, 2018). In addition, vertical villages lack sufficient playgrounds for children, harm the transport network, increase road congestion at peak times, require higher lift power, and have difficulties in waste and sewerage control, rescue, and emergency evacuation. Before starting such projects, social and environmental impacts must be studied and eliminated appropriately.

2.7 Waste Control and Green Material

Fast population growth promotes a staggering need for consumable items and synthetic materials; as a result, waste management, reprocessing, and control have become worldwide concerns and are crucial to sustainability and a regenerative economy (Clark, 2023; Rahman, 2024). The different industrial, chemical, medical, and household wastes are disposed of in landfills, by rivers and channels, buried or burned without recycling, and retreated. It creates environmental threats, emits greenhouse gases, and promotes the intrusion of microplastics into organisms and humans via food cycles (Rahman, 2024). Ultimately, it degrades air quality and deters social attributes. Recycling waste creates new jobs, saves energy, and reduces air, water, and soil contamination. Single-waste item recycling significantly impacts sustainability, achieving air quality, and a regenerative economy (Rahman, 2024). Therefore, researchers are investigating recycling various wastes, such as animal hair, fruit husks, ashes, and industrial and medical waste, to develop green composite materials and a circular economy (Mobarak et al., 2022; Rahman et al., 2023). Besides, plant-based natural fibers, such as jute, bamboo, coir, hemp, banana fibers, sisals, etc., are also implemented to develop decomposable, eco-friendly, and recyclable composites (Rahman et al., 2022, 2024). It will aid in substituting synthetic fiber-based composites and plastics with bio-composites, decrease environmental pollution, enhance global sustainability, and develop a regenerative economy, ultimately improving life quality and social features.

2.8 Robotics, Artificial Intelligence (AI), and Automation

Artificial intelligence (AI) is the most significant development of modern science, which will impact social life and the economy to a great extent (Choi & Kim, 2023). People are already worried about its consequences. From school assignments to research articles and legal documents, replicas of voices, videos, pictures, and scenarios can be developed by AI systems within a fingertip, like factual facts, and it will replace 300 million jobs by 2030 (Talmage-Rostron, 2024). It will create a legal and ethical conundrum, identity theft, cybercrime, and hacking if rules and regulations are not implemented with a moral and legal boundary. If the AI system is used in every aspect of life, people's thinking ability, judgment, creativity, and cognitive development will be deterred. AI will not only remove people from jobs, but it will also be used to create social and ethical chaos, conflict, segregation, and even war by gangs, groups, and nations by creating artificial facts, scenarios, and speeches. Besides, it can be used to boost biases and discrimination within society (Qian et al., 2024). AI and robotics systems work with numerous intelligent neural systems within the boundaries of algorithms, codes, and logic, limiting flexibility and self-adjustment to incorporate evolving situations and out-of-code phenomena. Even AI and robotic systems are claimed to work independently, but without human intervention, the application of AI and robotic automation will not be successful. They will enhance productivity and reduce costs with human intervention. The economy of highly skilled people will flourish, but a significant number will lose their jobs due to a lack of skills and know-how. Social conflict will increase due to the income gap between different layers of society. Human replica robots are also able to accomplish household and business work. Therefore, social communication and interactions will be reduced to a great extent, and people will suffer psychological trauma due to the lack of heart and soul bonding as inventors develop to replace wives and friends with replica robots. Therefore, marriage, birth rate, and family bonding will degrade due to the rapid development of human replica robots, automation, and AI systems. Though modern innovation and development are intended

to improve the quality of humans, they severely impact society and individuals if people are not aware. Before implementing automation and AI systems in all aspects of society and business, the societal impacts of these systems need to be examined.

3. LIMITATIONS OF THE STUDY

This study qualitatively evaluated the impact of modern innovation and research on society and individuals by exploring relevant and contemporary discoveries, events, and research. This study aims to raise awareness among people, society, and researchers about the detrimental effects of scientific discoveries and events. Therefore, this study has a limitation in the quantitative analysis of the impact of each field, discovery, and innovation on society and individuals. For quantitative analysis, it requires collecting statistical and scientific data for a certain time and for a particular innovation and event on a group of people, which varies on geographical location, ethnicity, colors, race, education, and progressiveness, as well as the nature and type of innovations and events. As a result, the quantitative analysis of this study is out of the scope. However, it opens a scope for future research and investigation.

4. CONCLUSION

Scientific innovation and development have pushed individual, social, and national attributes and comforts one step further over the last century. Recently, humans have encountered severe and periodic natural catastrophes, such as intense hot and cold climates, deluges, tsunamis, typhoons, landslides, droughts, wildfires, pandemics, etc., as well as society- and nation-driven detrimental events, such as mass shootings, riots, wars, ethnic clashes, and genocide. They are damaging environments, infrastructure, shelters, and agricultural land, causing the deaths of humans, wild animals, and livestock, besides severely affecting the socio-economic and psychological conditions of individuals and society as a whole. Some events happen due to environmental pollution caused by the abusive and inappropriate use of scientific innovations, technology, and human actions. Though scientists are innovating new technology and ideas with positive minds to improve life quality and social attributes, it has severe negative impacts on society if people are not aware. Incredibly unethical, uncertain, and inappropriate use of gene technology and cloning, cell phones, the internet, social media, spying equipment, nuclear energy, robotics, artificial intelligence, and automation could roll society backwards. Therefore, technology implementation needs to be bound by some ethical rules and policies. This study will help to understand and reduce the harmful effects on society due to the unethical use and inappropriate implementation of modern research, innovations, products, tools, mega projects, etc., as well as raise individual awareness. Besides the limitations of this study, it opens a scope for future study and quantitative analysis of the impact of modern innovation and research on individuals and society.

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AUTHOR DECLARATION

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