ISSN: 2395-7852

International Journal of Advanced Research in Arts, Science, Engineering & Management

Volume 10, Issue 2, March 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 6.551

+91 9940572462 +91 9940572462 ijarasem@gmail.com www.ijarasem.com

International Journal of Advanced Research in Arts, Science, Engineering & Management (IJARASEM)

| ISSN: 2395-7852 | www.ijarasem.com | Impact Factor: 6.551 |Bimonthly, Peer Reviewed & Referred Journal|

| Volume 10, Issue 2, March 2023 |

Overview of the New Innovation Approaches for Sustainable Environment

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ABSTRACT: There's never been a greater push for sustainable products and technologies than there is today. We've reached a critical point with regard to climate change, and many innovators and businesses are stepping up to the plate to build a greener future. Here are just some of the incredible examples of sustainable innovation that could change the world as we know it and pave the way for a more sustainable way of living.

KEYWORDS-sustainable,environment,innovation,approaches,living

I. INTRODUCTION

1. The Smog Free Project: Air pollution can now be transformed into jewelry

Daan Roosegaarde is the mastermind behind the world's first smog vacuum cleaner. The Smog Free Tower measures almost 23 feet high (7 meters) and sucks in polluted air, cleaning it through a process of ionization before releasing it again. At its peak performance, the tower cleans 30,000 m3 of air per hour.[1,2,3]

Thanks to Roosegaarde's design, you can even wear rings from the compressed smog particles collected from the tower. By buying and wearing a Smog Free Ring, you're contributing to over 10,700 square feet (1000 square meters) of clean air. The project has garnered a lot of attention since its inception, winning multiple awards. Recent tower campaigns have been launched in South Korea, China, the Netherlands, Mexico, and Poland.

2. Zéphyr Solar: An autonomous solar balloon bringing electricity to disaster zones

Zéphyr is a photovoltaic balloon and eco-friendly generator created by Karen Assaraf, Julie Dautel, and Cédric Tomissi and their France-based start-up EONEF. The autonomous aerial platform takes the form of a helium balloon. Operating individually or as an aerial observation network, the solar-powered balloons can be deployed in under an hour, can fly to 30 days at a time, are capable of withstanding winds of 43 mph (70 kph), and can fly at great altitudes.

The EONEF balloons can be used for a wide range of sustainability initiatives. They are being incorporated into scientific missions like observing wildlife and measuring air quality and can be used to promote coordination during a disaster. It is easily one of our favorite sustainable innovation projects to come out of France in recent years. [4,5,6]

3. The Green Building Initiative

The Green Building Initiative (GBI) is an international effort toward creating sustainable, resource-efficient buildings. They offer a certification program for commercial buildings that adhere to their environmentally-friendly vision. Their goal is to establish a standard of best practices for green buildings globally, as well as provide third-party assessment tools for sustainability requirements.

4. B-Droid: Robotic bees could help us build a brighter future

B-Droid is just one of several efforts to create robotic bees that can pollinate crops as effectively as their organic counterparts. B-Droid's mission is to help boost the natural bee population by giving robotic bees low-nutritional and high-labor pollination tasks.

Created by researchers at the University of Warsaw, B-Droid's vision consists of a managing platform and swarms of autonomous and semi-autonomous robots, which would have the ability to identify and pollinate crops effectively. Hopefully, this sustainable innovation does not turn into an episode of Black Mirror. [7,8,9]

5. Groasis Waterboxx: Growing trees in the desert is now possible

The Groasis Waterboxx was created by Dutch flower exporter Pieter Hoff. The Groasis is a planting device that makes growing crops in the desert possible and resource-efficient. It consists of an "intelligent bucket" made from recycled paper, which can germinate seeds, incubate saplings, and water plants. It requires 90% less water than traditional growing methods and can be used in some of the most extreme climates on Earth.

6. Supermarket Herb Gardens: Less Waste, Better Taste

Dutch supermarket chain Albert Heijn introduced in-store herb gardens in 2017 to combat waste and give customers the freshest possible produce. The initiative was developed in collaboration with a design agency studiomfd. The herbs are grown to maturity off-site before being transported to stores.

Customers can then cut as many sprigs of the herbs as they need without buying pre-packaged sprigs. It's a simple and effective way to cut down on plastic packaging. Projects like this are examples of simple sustainable innovations with far-reaching positive implications. You could also try to grow your own herbs at home. [10,11,12]

7. AirCarbon: A sustainable plastic for the future

AirCarbon was developed by Newlight Technologies and has already won many awards for its innovative sustainability. It's made from carbon emissions that would otherwise be released into the air and can have a multitude of uses. It's a verified carbon-negative material, meaning every step of its production and use is fully green and sustainable. Because it is not made from oil like other plastics, it is also a cost-effective alternative to other synthetic materials.

8. Solar Glass could cover your home in the future

Solar glass could change the way we create homes and commercial buildings. Researchers at the University of Michigan are developing solar glass, a sustainable engineering project that has generated a lot of buzz in recent years. Just as the name implies, solar glass would be able to capture and store solar energy.

According to the research team, 5 to 7 billion square meters of usable window space exists, enough to power a full 40% of US energy needs using solar glass.

9. ENGIE Insight: Providing resources for a sustainable world

Formerly known as Ecova, ENGIE Insight is a sustainable resource management initiative that works with businesses to reduce environmental impact. They provide technology and experts to help businesses become more sustainable and reduce their carbon footprint. To date, they've worked with AMTRAK, GameStop, and others to create resource-efficient business practices that don't harm the environment.[13,14]

10. Demetra: Reducing food waste organically is easier than you think

Created by an Italian start-up Green Code, Demetra is an all-natural treatment for food preservation. It's made from 100% plant extracts and can improve the shelf life of natural produce.

Thanks to Demetra, produce would no longer need to be kept at cold temperatures while in transit, saving a lot of energy. The product also helps produce to stay fresh and ripe longer, effectively reducing food waste in supermarkets and groceries.

11. The Seabin: Cleaning the oceans safely with trash bins

The Seabin was created by Andrew Turton and Pete Ceglinski, two surfers who wanted to clean up the world's oceans. The Seabin can filter out plastic, detergents, and oil, allowing clean water to flow back out. Inside the bin is a catch bag, which traps any floating pollutants.

A submersible water pump sucks water through the bin, passing it out again once it has been cleaned. It only needs to be emptied once a month and could greatly impact water pollution in ports and harbors worldwide. Sustainability engineering for the win!

12. S.Café: Fabric created with recycled from coffee grounds

S. Café has created a method of transforming coffee grounds into wearable textiles that are more energy-efficient and faster to produce than traditional natural fibers. Their patented yarn dries 200% faster than cotton and can be produced with low temperatures and little energy. In addition to this, the yarn naturally absorbs odors and reflects UV rays, thanks to its unique micro-pores.

13. Sundrop Farms: Energy-Efficient Agriculture

Sundrop Farms is known for cultivating a set of sustainable agricultural technologies that require fewer finite resources than traditional farming. This sustainable agricultural project depends on concentrated solar power and thermal desalination. Their farm in Port Augusta, South Australia, is irrigated with water drawn from the Spencer Gulf,[15] which is desalinated before being used to feed the crops. This desalination process, along with other operations on the farm, is entirely powered by solar power.

14. The Veganbottle: An All-Natural Alternative to Plastic Bottles

Created by LYSPACKAGING, the Veganbottle is made from an all-natural bioplastic that could replace plastic bottles forever. Everything in the Veganbottle, from the cap to the wrapper, is made from 100% biodegradable materials. The bottle is made from sugar cane extracts. Sugar cane requires far less water than other crops, and the bottle's manufacturing uses less energy than conventional manufacturing.

15. PowWow Energy: Save water and money with this innovative app

PowWow Energy is an app that messages farmers when there's an issue with their irrigation system. They offer two products - a Pump Monitor to reduce water waste and an Irrigation Advisor to ensure the best possible crop yield.

Their products allow farmers to monitor their own data when it comes to water usage and identify pipe leaks or breakages immediately. Users only receive messages from the app when there's an issue, allowing them to efficiently avoid waste and get the most out of the crops.

16. Eka 1 and Eka 2 Seeds: A proposed solution to deforestation

Palm oil production has long been linked to widespread deforestation, as huge rainforest areas are cleared to cultivate the product. However, this needs no longer be the case thanks to new seeds developed by Golden Agri-Resources.

Plants grown from the new seeds, known as Eka 1 and Eka 2, could produce up to three times the amount of oil than the current industry average. The modified seeds would also mature faster and would be less susceptible to drought and disease.[2,3,4]

17. CloudFisher: Converting fog into drinking water

Created by Aqualonis, CloudFisher could allow people living in coastal or mountainous areas to convert fog into safe drinking water. This water can also be used to irrigate crops or for forestry efforts.

It's made from a 3D mesh that can withstand high wind speeds while still retaining water. It comes in a variety of sizes to suit individual needs or the needs of an entire village. The green innovation example is already being used to help people around the world.

18. Fairphone: The world's first ethical smartphone

Fairphone is a modular smartphone designed with fair work practices and recycling in mind. To combat the growing waste caused by discarded electronic goods, Fairphone created a long-lasting smartphone that can be easily repaired.

Rather than replacing the entire phone if part of it breaks, Fairphone allows you to replace the broken module simply. Everything from the battery to the audio jack can be replaced, meaning fewer phones will end up in landfills.

19. Waitrose Delivery vans fuelled by food waste

Last year, British supermarket chain Waitrose introduced a new fleet of eco-friendly delivery vans. The vans run on biomethane, a sustainable alternative to fossil fuels. Delivery vehicles are responsible for high levels of carbon emissions, and finding green alternatives to gasoline and diesel-powered delivery systems is crucial. Vans like the ones used by Waitrose could be a game-changer for delivery fleets across the world.[5,6,7]

20. Bakey's: A Delicious Way to Replace Plastic Cutlery

Created by Narayana Peesapaty, Bakey's is a green alternative to plastic cutlery. Plastic cutlery cannot be recycled, and thus results in great amounts of waste every year. Bakey's is a brand of edible cutlery which comes in three different flavors: plain, sweet, and savory. They're 100% natural, vegan, and will biodegrade if not eaten.

21. Outerwall EcoATM: Get Cash For Your Old Electronics

Discarded electronic products account for huge amounts of waste, and recycling efforts are ramping up to encourage people against throwing away their old gadgets. One initiative is the EcoATM - a machine that gives you money in exchange for your discarded devices.

All you have to do is bring your device to an EcoATM kiosk, where it is evaluated and valued, and you can walk away with money directly transferred to your bank account, PayPal, or vouchers! A great incentive for staying green.

III. DISCUSSION

People often describe sustainable development as requiring a joint and long-term outlook by society that integrates social, economic and environmental objectives. Today, the private sector's contributions come from developing and using environmentally better, eco-efficient, ways to produce and provide products and services and by creating wealth and employment respectful of changing expectations of corporate responsibility and behavior. Delivering and extending this contribution beyond eco-efficiency depends upon the continued innovation that effective design and the development and use of better technologies will make possible. [8,9,10]Sustainable development is a metaphor for opportunity and progress as well as a reminder of obligations and uncertainty. It requires a step-change improvement in performance. Merely doing better what we are already doing is not sufficient to meet the needs and aspirations of a growing world population with dignity. At the same time, commercial success depends upon carrying out business in value-creating ways. Increasingly, the World Business Council for Sustainable Development (WBCSD) believes that this can be achieved by addressing innovative opportunities that reflect changing social expectations and support a transition to greater sustainability. Whereas our research suggests that no single approach will apply to all firms in all situations, some common underlying principles emerged, which are summarized below. 1. Sustainable development offers an organizing framework based on opportunity and respect for human values. Innovation is about using change to better meet human needs and values. The connection seems obvious although it is hard to realize in the absence of clear market signals and a common language, especially since innovation can come unexpectedly "out of left field" and have uncertain consequences. 2. Better design and new technologies provide the means to act smarter and more sustainably but this technology also creates uncertainties, for example about the consequences of the scale and scope of application. Using these tools well depends upon understanding what the public is expecting and being able to meet these needs cost-effectively and without raising alarms and fears. 3. The process of innovation is taking place within increasingly networked economies with changing social values and growing environmental pressures. While these forces are unavoidable, they are not unmanageable. Successful commercial approaches depend on having the flexible, multidisciplinary skills to respond to this changing context. Sustainable development is not unusual in this respect.

4. Within developing nations in particular, technology's contribution to sustainable development comes largely through business-to-business transactions. Here, the large gap in performance is typically not a consequence of the lack of cost-effective technologies. The priority is to increase the capacity to apply available solutions well. Key focus areas are to develop skills and capacity especially in the small-and-medium enterprise (SME) sector and to find ways to reduce project investment risk. Overseas Development Assistance (ODA), Foreign Direct Investment (FDI) and the newer flexible market instruments such as the Clean Development Mechanism can be brought together to support innovative and effective public-private partnerships to address these points. 5. In some situations, people respond best to sustainable development as a vision,[11,12,13] whereas in others, more pragmatic approaches work best. Whichever approach is preferred, innovation often comes from facing strategic dilemmas that can only be resolved by finding new approaches. This is one reason why credible stretch targets can be an effective way to secure major improvements. 6. The leadership task is to harness economic and social trends, capture the tremendous amount of knowledge and experience that exists in networks worldwide and combine these in ways that command respect, generate enterprise and create value. Traction is likely to be greatest when the management approach is positioned appropriately for the company in its network and seen by staff to be relevant and self-evident, if not simple, in purpose and content. This needs clear direction backed up by resources, management support and good metrics. 7. We believe that achieving this requires extending the principles of transparency and learning, corporate social responsibility and ecoefficiency throughout the innovation process. This process extends from research and development through technology selection and use, product and service design, investment and employment policies and global and local business activities, as well as to issues management and government relations. In summary, the commercial challenges are to learn to treat sustainable development as a framework for innovation and to use and extend established management principles to make this framework operational and effective. Already, leading companies have demonstrated the willingness to express what they stand for and in turn understand what society expects of them. These companies are actively developing and incorporating the tools to improve performance across the three pillars of sustainable development. They are learning how to stimulate innovation and are setting focused targets that measure progress and assure the link between their own values and those of their customers. But there is much more to be done and important lessons to be learned and applied, especially to obtain innovation that addresses the social pillar of sustainable development. There are many ways in which other stakeholders can assist these efforts. For example, governments can design regulatory frameworks that set the direction, encourage and reward the experimentation that fosters innovation and improves sustainability. They can demonstrate (through procurement policies and the information provided to the public) that they are committed to achieve the same objectives being expected of others.

IV. RESULTS

Firms have used technology as an engine of progress since at least the time of the Industrial Revolution, which gave remarkable ways to marshal the physical world for human benefit. Innovation, which we use to mean the successful implementation of new developments and ideas, depends upon much more than technological advance, but technology has consistently provided the opportunities from which to make and sell better goods and services and to do so more cleanly and more safely. Many of today's social and economic developments are a result of technical discoveries and developments in fields such as communications, information processing, health sciences and energy supply. These promise smarter, more tailored solutions to the tasks we wish to accomplish. Rather than being monolithic in approach, the tools are used by dynamic and responsive networks of small and large, public and private organizations, working together and in competition in ways that were never before possible. The changes are tremendous and the opportunities profound, but it has become clear that technology can only be part of achieving a more sustainable development and its contribution is not always as positive as we might wish. Furthermore, other factors that can drive and support progress are themselves changing and need to be understood. For example, the well-defined social categories for which post-war Western institutions were designed no longer fit well with people's aspirations and values. Richer countries are experiencing a shift towards an increasingly multidimensional and diverse "Mosaic Society",[13,14] with uncertain needs but very real concerns about many subjects including science and technology. At the same time, despite there being greater affluence than at any time in history, most of the world's population remains poor yet increasingly aware of its relative poverty. For these people, the economic and social benefits of globalization and global markets are increasingly being questioned. Many other writers have offered cogent, visionary ideas of the improved sustainability that can be obtained by marshaling recent developments. The focus of this paper is on how firms can organize themselves to realize these opportunities in ways that will benefit and be acceptable to society and also create the value that permits them to remain in business. The approach that is suggested is based on understanding how companies have handled the concepts of corporate social responsibility and eco-efficiency, examining how they are now managing innovation and technology and finding ways that will bring these approaches together in today's and tomorrow's economies. Leading companies have built their approaches to sustainable development upon principles that can be summarized as follows: • Ensuring the corporation understands what society expects of it, in return expressing clearly what the firm itself stands for, then reinforcing these values in ways that stretch the organization and create a spirit of

continuous improvement. (Attitude) • Developing the tools and approaches to improve performance across the social, environmental and economic pillars of sustainable development and incorporating these tools within routine business processes. (Build the capacity to act)[15]

• Setting focused targets and putting in place the means to measure performance and confirm that the targets are being achieved. (Check progress) For existing business operations undergoing normal business development, these are mutually reinforcing principles. They provide a positive and effective framework that firms can use in mitigating environmental impact and allaying public distrust. Whereas twenty years ago, most companies based performance standards on regulatory requirements, today many choose to go beyond regulation because they see commercial benefit in doing so. Established practice in areas such as safety and quality management has demonstrated that uncompromising principles are perfectly compatible with the spirit of continual improvement. Stakeholder dialogue now helps firms learn more about others' points of view and then use this understanding to set better priorities and move away from confrontational approaches. In extending systems of financial control and audit to cover environmental impact, they have recognized the need to gain early "buy in" by ensuring relevance to the specific priorities of individual business units. Technology is playing a central role by providing the means to move forward and engineers generally seem to relish the opportunity to find more eco-efficient solutions once the parameters for improvement have been established and agreed. The stock market returns achieved by those companies included in the recently launched Dow Jones Sustainability Index suggest that investors are now recognizing the management qualities that have made this progress possible. Good Enough or Could Do Better? This is intended to be a rhetorical question. During the last decade, the arguments and counter-arguments about rates of improvement have been well rehearsed. Economic focus leads to "short-termism". Regulatory frameworks offer too much (or too little) "command and control", so we are not properly pricing public goods, environmental services and social well being. New approaches are uneconomic in the face of established manufacturing capacity. Undesired impacts are associated with large, interdependent infrastructures (for example, the car, its fuel and the city), so require more systemic approaches that can transcend traditional business and political boundaries and avoid stranded assets. Technical progress is slower than expected, gets sidetracked through lack of customer pressure or creates "rebound effects" by stimulating new demand that consumes the improvements that have been achieved. These concerns are valid but (with considerable effort and a fair dose of humility) there are ways to overcome them. In some cases, effective solutions are already available; in others, we may need to change the market's rules of the game. For example, it seems likely that economic instruments such as tradable carbon emissions permits will improve the market's effectiveness in dealing with climate change. Demonstrating that these instruments do work well requires agreement on rules and modalities and the willingness to take action and learn from our mistakes.

In other words, sustainable innovation involves risk but it also requires structure. While much can be achieved by "continuing to do better", it will be far more challenging and rewarding to learn how to: • Bring design, smart technologies and the "new economy" together to drive growth in ways that reflects changing concerns and values of a connected world • Support faster and more sustainable development in the developing nations We believe that success with these tasks can turn sustainable development into an approach that is intrinsically value creating. But we also believe that some established ways of doing business and the assurance processes that accompany them will need improving in order to achieve this. For example, sound science is a lynch pin of corporate approaches to technology risk management. Even though no one questions the need for high safety standards, too much recourse to scientific evidence and argument can now seem complacent and paternalistic. The public's sense of the role of technology has changed and its awareness of previous mistakes has grown.[13,14,15] We need to find better ways to show that firms (and governments) are keeping their scientific houses in order. A paradox is that the success of today's activists owes much to their mastery of communication technologies in getting their messages heard. Governments, inter-governmental bodies and corporations now find themselves to be hopelessly cumbersome in the face of resolute single-purpose advocacy. Stakeholder dialog offers a powerful way forward but requires that we learn how to achieve open discussion about subjects for which the risks seem large and the benefits unclear. 2. Thinking about Innovation and Technology In preparing for an uncertain future, we need a sense of what might develop while avoiding placing expensive bets on particular outcomes. Scenario planning offers one way to extend our strategic thinking. The WBCSD has used this tool in several projects and we have found the approach helpful in looking at the broad questions of business-led innovation and use of technology. The paper we contributed to the OECD's December 1998 workshop in Budapest gave a detailed assessment of the Global Scenarios. This section briefly summarizes these and our more recent Biotechnology Scenarios. The Global Scenarios (FROG!, GEOPolity and Jazz) explored sustainable development in terms of two parameters: Uncertainty: How we will recognize the resilience, limits and critical thresholds faced within the global ecosystem. Governance: What forms of social system can best respond to the challenge of sustainable development. FROG! describes a low-trust world in which people focus on jobs, economic survival and short-term financial returns. Although people believe they value sustainable development, local economic

pressures dominate their thinking. After all, people (at least those who are already affluent) find it obvious that their neighborhoods have become far cleaner, presumably because they have already adopted the right approaches.

V. CONCLUSION

One way to formulate the question of balance is to ask what corporate social responsibility means for companies operating within a networked world. The research described above suggests that no single approach will apply to all firms in all situations, but there are some clear common principles: a) Sustainable development offers an organizing framework based on opportunity and respect for human values. Innovation is about using change in ways that better meet human needs and values. The connection between the two seems obvious although, in the absence of clear market pressures and a common language, can be hard to realize, especially since innovation can come unexpectedly "out of left field" and have such uncertain consequences. b) Some organizations respond best to sustainable development as a vision, whereas others prefer more pragmatic approaches. Clear direction backed up by resources, management support and good metrics seems more likely to achieve the desired results than reinventing business processes to accommodate sustainable development. c) Whichever approach is preferred, innovation has often been the result of presenting (or being presented with) a credible strategic dilemma: a shock that can only be resolved by developing wholly new approaches. d) Economies are networked, social values are changing and environmental pressures are here to stay. These are unavoidable but not uncontrollable forces. Commercial success depends on having the flexible, multidisciplinary skills to respond. This applies as much to sustainable innovation as in any other area. Metaphorically, we must ask ourselves whether to concentrate on stopping the tide from coming in or using it to get where we want to go. e) Innovation based on better design and new technologies gives us the means to act smarter and more sustainably. Using these tools well depends upon understanding the public's expectations and concerns and being able to meet needs cost-effectively without raising further alarms over the scale or novelty of technology. f) The leadership task is to harness these economic and social trends, capture the tremendous amount of knowledge and experience that exists in networks worldwide and combine these in ways that create value. Traction is likely to be greatest when the management approach is positioned appropriately for the organization in its network and seen by staff to be relevant and self-evident, if not simple, in purpose and content. g) Corporate social responsibility and eco-efficiency form important elements of the business response. Attention to these principles must be devolved throughout the corporation.[15]

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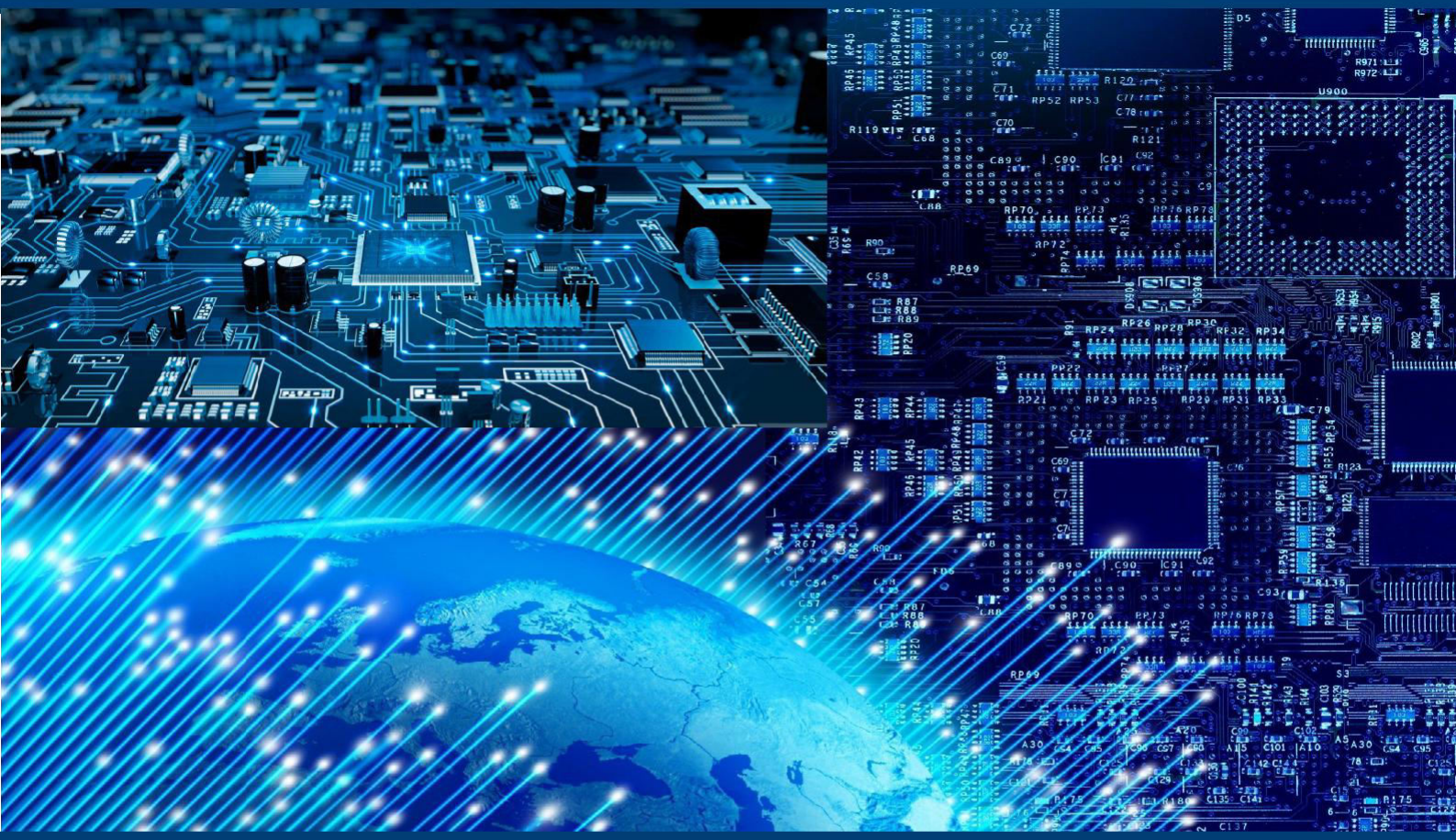

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