

# Conceptual Framework of Adoption and Implementation of Technological Challenges – A Road towards Sustainable Development

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## ABSTRACT

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As we all know that nothing can be produced without the involvement of factors of production. However, the involvement of intensification of various factors of production differs from product to product, region to region and firm to firm around the world. In this regard, without any second thought or opinion that technology is holding the driver's seat in economics, the road takes forward. Nothing is so important around the world that it is not giving any significant efficient contributions to the respective sectors, industries and firms in a state. Predominantly, technology allows progress toward efficient production and better goods and services. Nonetheless, in reality, the advancement of technological progress used is very complex, especially in highly populated developing countries like India with respect to policy implications and the decision-making process of the firms or the industry. Since, the bilateral linkage is observed by technological advancement with different variables like education, socio-economic growth, innovation, production and turnover ratio and so on. But, the likelihood of impact on reduction in the demand for labour force, widening of inequality in the distribution of wealth among the people and social responsibility needs to be ensured for the welfare by the regulators are also not to be neglected. The advancement of technologies and adoption of the same on the one side increases the flow of knowledge expansion, cooperation among the investors improves emerging businesses around the world. On the other side, the fabrication and challenges on multiplication of various inventive activities of the corporate world like automated systems, big data, development of information and communication technologies, artificial intelligence, patient, recipes, protocol, routine instructions and manuals also become inevitable to sustainable development. This paper is intended to review the challenges of adoption and implications of technological advancement toward sustainable socio-economic growth.

**Keywords:** Automation, Communication, Duplication, Intensification And Sustainability.

## Introduction

Certainly, nobody denies that technology is the composition of knowledge and tools which simplifies and makes out the factors and resources easily, efficiently, effectively, creatively, and innovatively in the transformation process of goods and services. The growth and development of technological advancements are not only shaping the countries' economy at the domestic level even across boundaries around the world. Self-reliance and sustainable development are the focused slogans of the state around the world in the recent past. Many forums including the World Bank, IMF, and UN councils are predominantly extending their fullest effective support, consideration, and consciousness in the attainment of those goals. In this regard, the key impact of technological advancement on self-

reliance and sustainable development of the state is needed to be protected and allotted with sufficient resource mobility and recognition. The technological changes after the implementation of LPG (liberalizations, Privatization, and globalization) i. e. the 90s have grown unimaginable state with respect to socio-economic, political, cultural, behavioural, and environmental aspects around the world. The rapid technological advancements around the world are also grown with multiple tasks and challenges. On the one side, the innovation systems and approaches are made out of the compositions of various elements invented in different parts of the world. It highlights the improved and expected existing extensive cooperation, strategies, and policy changes build to manage effective inventions and innovations at the regional, national, and international levels.

## Objectives of the Study

This article is made of the following objectives:

1. To review the conceptual framework of technology advancement theories relevant to sustainable development.
2. To evaluate the impact of technology transformations on various socio-economic indicators of sustainable development.
3. To analyze the challenges of technological advancements with respect to various contributors to sustainable development.

## Methodology of the Study

This paper is carried out with secondary sources. The theoretical economic models relevant to sustainable development with different socio-economic indicators such as standard of living, employment, income, communication, and human capital investments in health and education status of the state are evaluated in this paper.

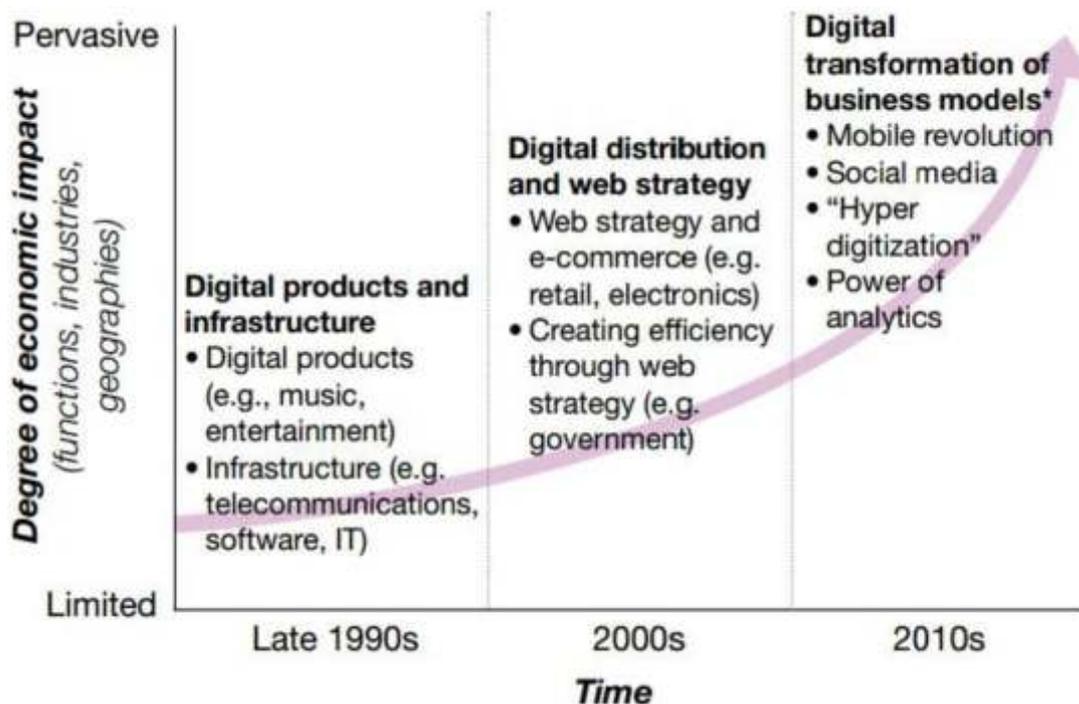
## Evolution Path and Theoretical Review of Technological Advancements

Presently, the whole world is focusing on self-reliance on technology to solve socio-economic and environmental issues. Certainly, technological advancements such as artificial intelligence,

biotechnology, blockchain management, 3D actions, drone technologies, nanotechnology, renewable energy technologies, robotics, satellite, and virtual learning advancements were all have taken the cultural and socio-economics into new paradigms. But the technological advancements along with the provision of freebies by the regulators (Government) on the other side also emerge challenges like migration, low wage rates and unemployment in the labour market. The commission of the Economic and Social Council itself understood the need for appropriate applications of science and technology and innovations for the attainment of effective sustainable development without which the achievement of the same will be highly impossible by 2030.

Attaining profit maximization is one of the prime objectives of the firms. The mechanisms such as increasing productivity, improving real income, and reduction of costs are the ways that help firms faster to achieve their objectives. UNCTAD has demonstrated the potential applications of frontier technologies to accelerate the progress to the attainment of sustainable development goals.

Chart – 1: Evolution Path of Digital Transformation

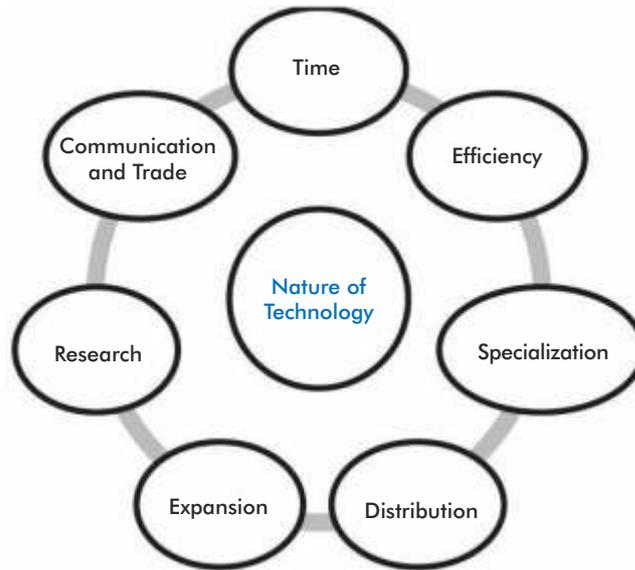


Source: Digital Transformation and Sustainability

The evolution of digital transformation over a period of time is projected in chart – 1. The degree of economic impact with respect to functions, industries and locations over the period of time is correlated in the chart. A direct relation is observed between economic variables and the time period in the flow chart since the 90s.

the techniques, capacity, business and market, involvement of the research and development and ICT impacts on trade. The nature of the technology component is also represented in the flow chart below.

**Chart – 2: Nature of Technology Components**



The nature of technology and its advancement is based on 7 core components time element, the efficiency of allocation and distribution, specialization and skill development, expansion of

The summary of the digital transformations to the sustainable development process of the state is presented in chart – 3. The description of digitalization and technological advancement to various sectors are also discussed in this section.

**Chart - 3: Summary of the digitalization related to sustainable development goals**



Source: ELSEVIER–Science of the Total Environment

## (1) **Agriculture Sector**

One of the recent reports has revealed that around 795 million people which means every 9th person are undernourished around the world. Most of them are from rural and developing nations. Indian economy is still considered a rural and agrarian economy; the majority of the people are living in rural regions and are based on agriculture and its allied activities. The impact of technological advancements in those sectors and in allied activities has highly influenced and affected the socio-economic status of the state. To some extent, the concept of “disguised unemployment” is controlled and eliminated in the agriculture sector by the implementation of technological advancements. Hence, it also made the regulators and policymakers think and create alternative employment opportunities for those unemployed people in the rural areas through SMEs, SHG, and MGNREGA with various preparatory and supportive works to strengthen the self-reliance and sustainable rural economic base of the country. The strong support and rapid implementation of MSME effectively and widely provide an improved platform for the people dwelling in the towns, cities, and corporation regions. Similarly, SHG and MGNREGA equally contribute to the dwellers in small towns and in rural regions in India. Generally, these types of policy executions are not only provided employment opportunities but also help to eradicate the vicious circle of poverty in the state. MSME schemes extend their support to nearly 50 different types of industry and service sector-based activities, SHG is focused on more than 30 sorts of business activities and MGNREGA tries to extend their activities with 10 broad categories like Watershed, Irrigation, and Flood management works, Agricultural and Livestock related works, Fisheries, Rural Drinking water, and Sanitation related works.

The impact of communication advancements and information sharing of production techniques across the world in agricultural productivity and similarly promotion of organic-based agro products is also felt by the people. Technological advancements like remote sensing, drones, and artificial intelligence in the agriculture sector facilitate precision farming and reduce chemical input usage and response to

variability in agricultural crop production. Hence, machine learning with drone and satellite imagery helps agriculturists to predict and carry out the ecological and economic weeding performance to maximize their quality plant hybrid yields. The continued research by the agencies and sufficient financial assistance for those works by the regulators provide a more innovative path to rapid technological changes and for the various dimension of food security and food systems forward to sustainable development. As a result, the attention of small landholders to enable putting suitable governance structure and in the flow of innovative scientific knowledge sharing.

## (2) **Power and Energy Sector**

The regulation of decentralization of power and renewable energy sectors has made room to extend electricity services to rural areas over a period of time. The increased investments into those sectors along with technological effective and efficient contributions have declined the prices for renewables, wind and solar generations in the international market.

Most of the developing countries' strategies have been made to them provide significant room for the advancement of renewable energy technologies around the world. The Republic of Chile is recognized as a pioneer in the electricity sector by the adoption of an energy mix with renewable energy transition. Canada was also working hard to prove that as the pioneer in the field and to become a leader in the clean technology sector along with unique challenges to access long term capital in the international market by recapitalizing to sustainable development. Hence, the improved machine learning algorithms techniques combined with artificial intelligence and innovative energy technologies help to forecast wind farm outputs, productions, energy delivery and distributions of the grids. Though the continuous rise in the general prices of petroleum products in developing countries like India is being an alarming factor for market transactions but the innovation of the advanced electric battery-based automobile industry is really the best alternative mechanism to the dynamic market demand. The history also provides evidence to us that the market

share of electric passenger care in China got increased from 2.1 per cent to 4.2 per cent in 2017 – 2018. This kind of innovation process not only is alarming the target need of demand and supply chain management of power and energy systems but also stimulates R & D towards affordability, regulatory environment, cooperation among the international bodies for knowledge sharing, policy learning, capacity building and development of interconnected infrastructure grids.

### **(3) State of Economy**

As Schumpeter has rightly pointed out in his theory of invention that the structural transformation of technological capabilities and market expansion promotes alternative sources of income and employment access and opportunities. As a result, the reduction of costs in frontier technology and increased opportunities to faster the progress from low wage to higher wage industrial activities increased and improved the beneficiaries' value chains in the developing countries around the world. A country like China is playing a leadership with respect to technological advancement in the production of photovoltaic, wind, and solar thermal heating, and Brazil was identified as the second-largest producer of liquid biofuels for transport. However, developing countries are making their level best to support smart manufacturing innovative systems of road map to economic growth. The multidimensional economic transformations such as incubators, accelerators, smart specialization, and technology parks need to be supported by the policy regulations.

### **(4) Social Inclusion**

A country like India took an initiative and implemented policy regulation of Aadhar to enable the financial inclusion of 128 crore people through demographic data with biometrics. Hence, the development of crypto transactions, blockchain technologies, digital identity, land registration, and many more financial transactions with the wide support of technological advancements in recent decades. The production, sales, and usage of digital techno-gadgets have increased significantly around the world in recent years. It is being a platform to improve the gross root social network movements for

knowledge creation and innovation among academicians, activists, and practitioners. Hence, it is also uplifting the solidarity of socio-economic status of the underprivileged, marginalized, and poor entrepreneurs across the groups.

### **(5) Medical and Healthcare Sector**

The growth of science and technology with respect to the medical and healthcare sector is also unimaginable. The development of comprehensive ICT solutions in a country has made Egypt a pioneer in the transformation of telemedicine, assessing medical and health-related services during the time of emergencies, crises, and critical situations by connecting physicians and field experts immediately in no time across the globe. As history revealed some communicable and chronic diseases such as dengue, and malaria could have been completely controlled due to rapid technological changes in the medical sector. The emergence of PPP into the healthcare sector including R & D, development of medical infrastructure, proactive policy changes, and involvement of the government is also evidence of technological advancements.

### **(6) Educational Sector**

Since 2010, the need and importance of digital platforms were felt by the people for multi-purpose and gradual growth observed across the world. But the unforeseen existence of Covid 19 and the pandemic situation brought the inevitability of the digital platforms and the significant increment at the grass-root level including the educational sector with limitless participation and with best packages. The imbibed characteristics of the 2k kids and untired interest of the youth men and women in the usage of the open internet access have improved the potentiality and accessibility of benefits of high-quality study materials and attending lectures, sharing content, methods, innovative ideas, self-paced learning and optimizing data analytics on the platform in the recent past. Most developing countries were started using 3D tools to enhance the curiosity of the learners in primary, high, and higher secondary school education systems and in the higher education institutions, colleges, and universities across the state.

Similarly, the technological advancement also

gives a way for the faculty and research community to collaborate in open labware sharing for quick, better experiments at low cost with various fields of sciences like Natural Sciences, Nano Science, Biotech, Neuroscience and so on. On the other side, this sort of integration of digital learning mechanisms is being a greater challenge and makes inter-experiment of learning curiosity to both teacher-researchers fraternities around the world with respect to assessments and strategies.

### **Impact and Challenges of Technological Transformations to Sustainable Development**

Technological advancements are also likely to have positive and disruptive effects on the attainment of sustainable development from various aspects. Certainly, the emerging new technological applications not only provide an enormous opportunity in the progress of sustainable development goals but also disrupts the market economy, worsen social divides and raise normative questions. The adoption of new innovative technological pathways facilitates the policymakers for good directions, distributions and diversifications, and also helps to avoid unwanted blocks, challenges and issues faced in the earlier systems in the context of sustainable goals.

#### **(1) Labour Market and Employment**

Technological advancements like artificial intelligence, big data and machine learning have an impact on market transactions and on economic indicators such as employment, productivity and growth. The impact of automation differs according to a range of factors, level of industrialization, factor costs, production costs and capacities, skill development strategies, demography, infrastructure and policy implications. Even UNCTAD was also taken the initiative to review the methodology used to estimate the impact of automation on the job market and from the earlier studies, it found that predominantly about the job losers rather than job creators. Moreover, digital automation may also affect men and women differently. On the one side, women hold high-risk jobs and are underrepresented in the field of science, engineering and technologies which increases job opportunities in the labour market demand. On the other hand, women are

employed in the less risky automation jobs used to get less pay than men for the same job. Despite the development of trade conduciveness and the increasing employment opportunities, the dynamic technology platform leads to wider income inequalities and polarization. Hence, technological advancements and innovations increase the plant's production capacity but on the other hand, it reduces the intensification of the labour force and ultimately oversupplies of job seekers in the labour market and finally reduces the bargaining power of the trade union with respect to their wage determination and working conditions. The effect of rapid technological changes highlights the need and importance of lifelong skill development updating the learning process. The development of a new innovative social compact novel approaches helps the people to deal with social safety nets and technological disruptions transitions. Hence, the required socio-economic implications through policy experimentations especially in developing countries.

#### **(2) Socioeconomic Divergence**

The likelihood of divergence of the existing gap with respect to socioeconomic aspects at the micro and macro level of the state due to technological changes is being another important vivid challenge of the state around the world. The change in the inter temperament of the factor intensifications between capital and labour resources in the production process perpetuates the milestones of socioeconomic status of the people within and between countries among rich and poor, rural and urban and women and men in the state. Recent studies had revealed that the use of information and communication advancements of the developed states are more than 4 times higher than in the least developed countries. As a result, it exacerbates socioeconomic divergence between countries at the frontier of rapid technological change. This situation alarms the rulers, administrators and policymakers to adopt and exercise innovation policy through the development of their technological advancements to cope with the attainment of sustainable development. Some of the studies also observed the increasing gender digital gap between men and women in the job market with respect to science, engineering technology and mathematics. For instance, in the leading machine learning-based

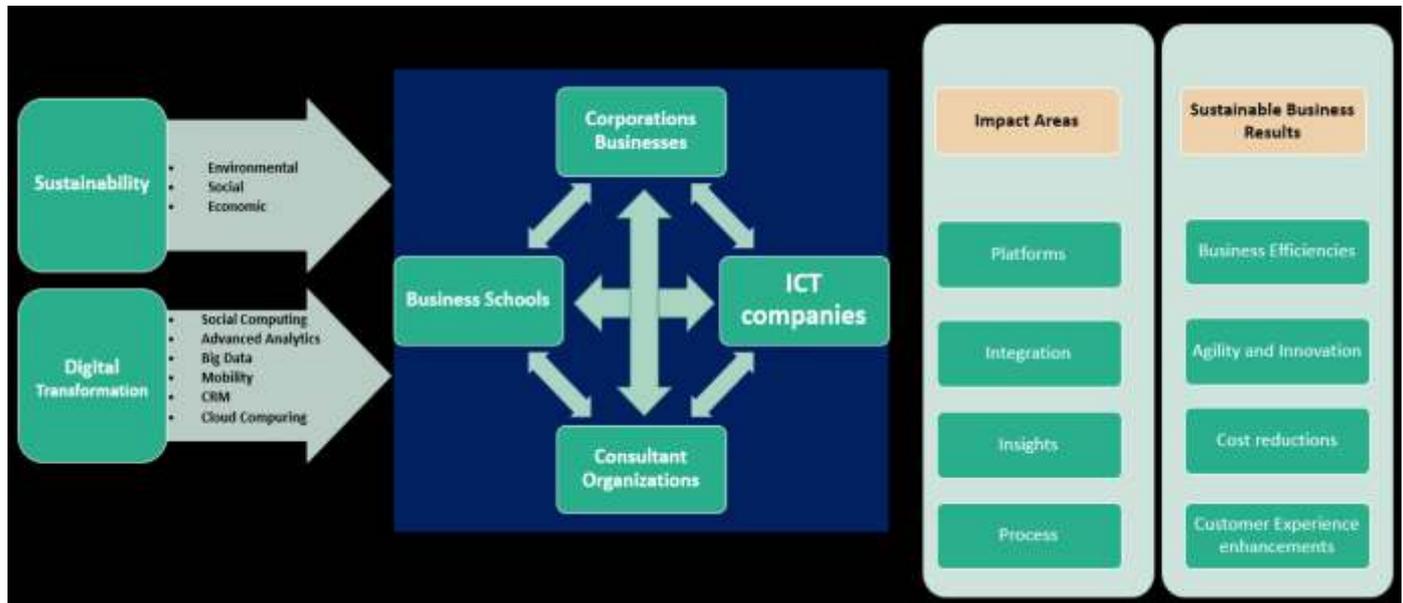
research only 12 per cent of the women represents. Hence, the biases were also observed in some of the applications of artificial intelligence or in big data due to a smaller number of women represented in those areas.

### Policy Implications for Sustainable Development

Technology advancement provides a way toward

progress delivery of sustainable development would be impossible irrespective of whether old or new technological innovation changes around the world. The agency of the National innovation system needs to interact with both public and private institutions for the adoption of new technology involved in the production process of the organisation. The growth and development of the economic systems of the

**Chart – 4: Policy Implications and Technological Frameworks**



**Source: ELSEVIER–Science of the Total Environment**

sustainable development through the emergence of socio, economic and environment. The policy implication toward sustainable development with the support of national science, technology and innovations, regional and international cooperation and multidimensional stakeholders are described here.

As the flow chart has explicitly revealed that the sustainability of the state is based on three important paradigms such as social, economic, and environmental factors. But the digital transformation of the state has been based on the composition of social computing, advanced analysis, big data, mobility, CRM and cloud computing, and so on. The impact of the policy implications of the regulators on various business activities and outcomes and sustainable development is based on numerous elements and indicators. Unlike the adoption of appropriate policy implementations and support of the rulers, administrators and bureaucrats the

firms and industry of the state are based on core technological innovation systems such as R&D, education system, civil society, consumers and policy regulators. The National science agency provides a pathway to use important technologies and for capacity building of SME based organisations. The basic mantra of consistency of those organisations is promoted through the design and development of appropriate policy and strategies adoptions. Gender and technology inclusive innovation policies may help the youth and women to take part as entrepreneurs or innovators. In the informal settings, innovation is also considered a source of sustainable development for the given informal small craft-based businesses to play a vital role in the adaption of external innovations to local conditions and to fill the gap when the production system change. Even the countries so specific on technology advancements, innovation, national science and technology-specific strategies translate those strategies and policies into tangible effects on pressing developmental

challenges and it is a critical issue.

Digital connectivity and policy are the key features and benefits of the digital economy. Digital competency is the combination of generic and technology skills which enable the understanding of the people on media, about what is retrieved and communicated with a variety of digital tools and applications. The proper education policies and training platforms are expected to be provided to all on digital skill development. The perpetual of this process not only develops the required potential investment in the basic ICT infrastructure, reliable energy supply and regulations but also ensures a competitive market space to provide the accessibility of the affordable quality product.

The stakeholders' cooperation in the regional, national and international communities can extend their support to rapid technological change towards sustainable development and helps to prevent it from widening socio-economic inequalities and environmental degradation. The increase in such support prevents the evolving digital economy from income inequalities. For instance, the share of ICT technology has grown a considerable collaboration in scientific research over the recent decades around the world. Hence, this process improves the understanding of networks' formation, norms, motivations, dynamics and internal control mechanisms of the market economy. The initiatives and contributions of the multi-stakeholders are also influenced their participants' resources to raise awareness about major challenges like gender digital diversifications.

#### The Outcome and Limitations of the Study

A summary review of the conceptual framework and drawbacks of the study are presented here.

- The conceptual framework review of the study seeks a common platform between digital parameters and business processes for the sustainable development of the state.
- The technological advancement and digital transformation of study mainly focused to analyze the impact and challenges of the elements such as artificial intelligence, big data, business innovations, social computing, customer and employee

relationship management, labour market, and capital intensification characteristics in terms of sustainability rather than traditional information technology technologies.

- The technological advancements and innovative business models keep the organization's strategy, operations, process, finance, and external forces very conducive and up to date by addressing the challenges and issues in the way management and different stakeholders deal with them.

The study is also subjected to the following limitations.

- 1) The study is fully based on secondary data which is subjected to the suitability of the organizations differs from region to region and strategy to strategy.
- 2) Though technological advancements and digitalization has become part and parcel of the human being and inevitable in the modern industrial world still it is a herculean task and challenge to developing countries.
- 3) The study consists only the conceptual framework of the technological advancements and its impacts on qualitative aspects, therefore no statistical evidence and estimation of the impact on various socio-economic indicators are not provided in the study.

#### Conclusion

The self-reliance, consistency, and sustainable development of a country are significantly dependent on the rapidity of technological changes toward the aim of policy execution and extensive support, cooperation, and consciousness of the workforce at all levels. The advancement of digitalization during COVID 19 increased opportunities to rethink the decision making of the state to apply technology in a new and meaningful way. The phenomenal opportunities to the existing firms, industries and enterprises which can use the data for more sustainable dynamic solutions. Hence, the present digital transformation is delivering the required sources, innovations and ideas to all stakeholders for their success. As the studies of Zegveld and Cramer revealed that where there is an increment in the purchasing power of the people to 70 per cent then there would be an incredible reduction in the

discharge of waste flows per product unit which would help the system to achieve the objective of sustainable developmental society. Hence, if the whole world wants a platform for the likelihood of equitable resource distribution with respect to the purchasing power of all the individual who expects to live at the same standard of living the total productivity of the state needs to be increased 10 times higher than the present. The perpetual impact of continuous rise in the growth of the population and environmental changes would raise the standard of material income status of the people around the world reflecting the same sort of consumption patterns of the industrialized countries. When the moment capacity of human ingenuity in the form of technology to preserve their lifestyle and also ensures an ever-increasing the level of consumption for everyone, and also the impulses the necessity of redesign the technological system rather than continue to apply the opt techniques of long term self-satisfactory events. The likelihood of fundamental social changes is ultimately based on optimum technological progress and the priorities are given to it by different stakeholders.

#### References

- Chandola, V. (2015). Digital transformation and sustainability: Study and analysis. Researchgate. [https://www.researchgate.net/profile/Vikas-Chandola/publication/292983072\\_Digital\\_Transformation\\_and\\_Sustainability/links/56b3a54808ae1f8aa453513b/Digital-Transformation-and-Sustainability.pdf](https://www.researchgate.net/profile/Vikas-Chandola/publication/292983072_Digital_Transformation_and_Sustainability/links/56b3a54808ae1f8aa453513b/Digital-Transformation-and-Sustainability.pdf)
- The Closing Circle by Barry Commoner (Knopf; 326 pp.; \$6.95). (1972). Worldview, 15(4), 60. <https://doi.org/10.1017/s0084255900015072>
- Cramer, J., & Zegveld, W. (1991). The future role of technology in environmental management. Futures, 23(5), 451–468. [https://doi.org/10.1016/00163287\(91\)90095-j](https://doi.org/10.1016/00163287(91)90095-j)
- Dosi, G. (1982). Technological paradigms and technological trajectories. Research Policy, 11(3), 147–162. [https://doi.org/10.1016/0048-7333\(82\)90016-6](https://doi.org/10.1016/0048-7333(82)90016-6)

7333(82)90016-6

- Jean, N., Burke, M., Xie, M., Davis, W. M., Lobell, D. B., & Ermon, S. (2016). Combining satellite imagery and machine learning to predict poverty. Science, 353(6301), 790–794. <https://doi.org/10.1126/science.aaf7894>
- Kumar, D. (2016). UN Commission on Science and Technology for Development. UN Commission on Science and Technology for Development. <https://static1.squarespace.com/>
- Lazer, D., Kennedy, R., King, G., & Vespignani, A. (2014). The Parable of Google Flu: Traps in Big Data Analysis. Science, 343(6176), 1203–1205. <https://doi.org/10.1126/science.1248506>
- Ledford, H. (2016). CRISPR: gene editing is just the beginning. Nature, 531(7593), 156–159. <https://doi.org/10.1038/531156a>
- Nelson, R. R., & Winter, S. G. (1977). In search of useful theory of innovation. Research Policy, 6(1), 36–76. [https://doi.org/10.1016/0048-7333\(77\)90029-4](https://doi.org/10.1016/0048-7333(77)90029-4)
- Schumacher, E. F. (1974). Small is beautiful. Google Scholar. [https://scholar.google.com/scholar?hl=en&as\\_sdt=0%2C5&q=Schumacher%2C+E.+F.%2C+281974%29+Small+is+Beautiful%3A+A+Study+of+Economics+as+if+People+Mattered%2C+Abacus%2C+London&btnG=](https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Schumacher%2C+E.+F.%2C+281974%29+Small+is+Beautiful%3A+A+Study+of+Economics+as+if+People+Mattered%2C+Abacus%2C+London&btnG=)
- Taylor, M. (2016). The power to change: solar and wind cost reduction potential. International Renewable Energy Agency (IRENA).
- Yunis, M. M., Koong, K. S., Liu, L. C., Kwan, R., & Tsang, P. (2012). ICT maturity as a driver to global competitiveness: a national level analysis. International Journal of Accounting & Information Management, 20(3), 255–281. <https://doi.org/10.1108/18347641211245137>