Digital and Sustainable Transformation for Global Consumer Electronics Manufacturers

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Abstract: - The study examines the influence of digital transformation on global consumer electronics manufacturing sector. The study first examines the background to digital transformation (DT), followed by a brief discussion on factors associated with the digital transformation process. This includes different factors like leadership and vision, existing digital infrastructure as well as the organizational culture. Exploratory studies explore the global consumer electronics market where continuous growth in the sector for the upcoming years has been seen as quite eminent. The impact of DT process on the consumer electronics manufacturer has been outlined, whereby digital tools like Internet of Things (IoT) have revolutionized the consumer electronic devices that are manufactured today. Along with this it has also been seen that technological advances have initiated a shift towards the production of smart devices as well. The study discusses the advantages of digital transformation in context to consumer electronics business sector as well. As is evident through the introduction of digital tools like big data, AI, blockchain technology, different business processes like demand forecasting, customer service, and supply chain management have become hassle free. However, there are possible complications in adopting digital transformations as well. Like inability to optimize the legacy systems with the new age digital tools, resistance to change etc. Along with this, certain recommended steps have been discussed as well. Like creating a detailed map for digital transformation, creating favorable culture for digital transformation.

Key-Words: - Digital Transformation (DT), Sustainable Transformation, Global Manufacturers, Consumer Electronics, Digitalisation, Sustainable Development Goals (SDGs), Green Thinking, Supply Chains

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1 Introduction

The last few decades have seen a significant transition in the electronic products organization, brought through a variety of causes including changing consumer tastes, technology breakthroughs, and emerging marketplace factors (Kraus, et.al., 2021). In this research paper, various technological advancement and development will be highlighted. The paper will also discuss how electronics for consumer's manufacturers and distributors requires innovative applications to improve their manufacturing processes, ensure the standard and compliance, increase performance and teamwork. By any norm, it is a challenging task, or the organization that utilizes outdated, cumbersome outdated software and traditional methods is suffering as a result. The adoption of cutting-edge programmes, innovations, and company practices deemed simpler and more automatic versus traditional company practices and procedures is just one aspect of digital revolution; there are other key aspects as well. The paper points out some of the key variables influencing this quick transformation involve the excellent value and inexpensive price of consumer electronics devices. Featuring the rise of technology, people regularly seek out products featuring the best possible effectiveness, longevity, and dependability (Christof, et.al, 2018). Adaptive, agile, and lean manufacturing has been slowly taking over the electronic industry. Manufactures involved in automated components and full devices, including production, gearbox, installation, and evaluation, have more difficulties because of the requirements for manufacturing. Excellent velocity, preciseness, and dependability standards as well as the capacity to produce a variety of unconventional goods need transformation (Nadeem, et.al.,2018). The metaverse, a world that provides an interface across reality and virtual reality, can be accessed physically using virtual and augmented reality technology, which in turn serves as the technological base for the software that supports the ecosystem.

1.1 Research Rationale, Aim and Objectives

The consumer sector of electronics Scale is a significant company which has been rapidly growing. Zion Industries Studies released inquiry suggesting that this sector of the economy will increase at an average annual growth rate (CAGR) about 7.6% in 2022- 28. The worldwide demand for electronics for consumers is projected to have a value worthwhile USD 1.10 trillion on 2021 and will develop to roughly USD 1.70 trillion within 2028 (Mergel, et.al.,2019). The manufacturing sector has been influenced by a variety of variables, among them including growing consumer financial resources, an increase in the digital transformation and automated processes, or an increase within the use of personal digital devices like mobile phones, notebooks, and other types of electronic gadgets. Throughout the period to come, the marketplace for consumer electronics is expected to keep growing. Recent technological developments and evolving customer tastes are anticipated to remain the main forces driving growth and competitiveness within the industry. According to Van, et.al., (2022), The phrase "customer electronics industry" describes a sector of the world's financial system which is responsibility of manufacturing electronics meant for domestic use, including cell phones, laptops, tablet computers, TVs, gaming systems, and other electronic devices. The main driver behind this marketplace's expansion lies in the never-ending quest for fresh products with superior characteristics and features. One example of the current trend of the utilization of digital electronics is the well-liked feature of unlimited shipping and quick deliveries. According to a new poll, 81% of customers anticipate their electronic purchase to be delivered less than seven days, and 80% of customers anticipate complimentary shipping above a specific threshold (Strange, et.al.,2022).

Additional companies and platforms are consequently increasing shipping bonuses to maintain ahead of the need and fight against Amazon Prime shipping. As innovative innovations emerge, the consumer electronics business is always changing and developing. Internet of things, 5G connection, AI, and other dimensions like the Metaverse are a few examples of these advancements. All the changes will have an impact upon marketplaces and help to change customer wants and behaviours.

The **aim of the study** is to examine the impacts of digitalisation and sustainability transformation within global consumer electronic providers. It would lay emphasis on the digital transformations which have taken place to bring about consequent advancement in the sustainability framework of the organization. The **objectives of the research** are as detailed below:

To study the impact of digital transformation (DT) on consumer electronics.

To examine DT impact on global manufacturers.

To investigate the role of DT on sustainability among global manufacturers.

To study impact of sustainable transformation on consumer electronics.

To study how digital and sustainable information impacts global consumer electronics manufacturing.

The **research questions** are summarized below:

What is the impact of DT on consumer electronics?

How has DT impacted global manufacturers?

What is the role of DT on sustainability among global manufacturers?

What is the impact of sustainable transformation on consumer electronics?

What are the ways in which digital and sustainable information can improve its impact on the global manufacturing industry of consumer electronics?

1.2 Research Gap

It could be interpreted that the manufacturing sector for home appliances and electronics within a sector haven't escaped the brunt of the worldwide crisis. On the opposite side, notwithstanding a general drop in intake, they are seeing a rise of sales in various kinds of products. The electronic goods sector nonetheless faces the same problems as numerous other areas of the market right now, regardless their positive sales numbers. Most of the electronic & domestic appliance manufacturing around the globe now relies heavily upon China. Through the acquisition of essential components to the production, assembly, evaluation, and global distribution of finished goods, a variety of critical steps in the manufacturing chains are in China. Manufacturers of electronic goods require trustworthy and safe technologies like never before to oversee what they do, promote communications among their employees as well as between vendors, resellers, and marketers, and keep track of both their stocks and catalogues of products on a worldwide level. There is huge change in the overall technological society. A comprehensive digitization process requires effective management of changes. It entails putting employees and groups across an organization in the best possible position for embracing and adapting to innovations. It is a challenging endeavour that frequently encounters opposition, confusion, and dread. Change management has become increasingly difficult and crucial because of this rapid and frequently large-scale aspect of the shift towards digital technology.

2 Literature Review

Consumer electronics manufacturers been concentrating their attempts to transform themselves digitally using omnichannel commerce and specific goods purchases over generations. However, it has turned nearly difficult for conventional stores to remain competitive on inventory, logistics support, or pricing in comparison to that of the online business, that offer consumers greater openness and preference, along with advanced logistics help and more usability of items (Garzoni, et.al.,2020). Thus, the literature review explores on ways digital transformation has affected as well as transformed the consumer electronics market. This digital transformation has pushed the companies to maintain sustainability among the manufacturers globally. The papers will also discuss about the transformation which is purely sustainable.

2.1 Impact of Digital Transformation on Consumer Electronics

The incorporation of technological innovations across every department in an organization is known as digital transformation (Strange, et.al., 2022). It has a huge effect on how a company performs operations. Organizations from all sectors enjoy the advantages of digitization: It allows companies to update antiquated procedures, quicken productive operations, enhance privacy, and boost revenue. The consumer electronics market is no different from other sector. The key elements of Digital Transformation are shown in **figure 1**.

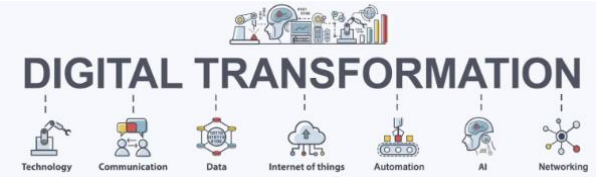


Fig. 1: Key Elements of Digital Transformation
Source: created by the authors.

Improved gathering of information - Most organizations including consumer electronics collect vast amounts of client information, yet the true gain comes from optimizing this information for analytics which can advance the consumer electronics segment also. A framework for acquiring the correct information and completely integrating it to create business insight at an additional layer is created via the digitization process. It develops a method by which several divisions of function across an organization dealing with consumer electronics can convert unprocessed information into information at numerous interactions. This results in one complete view of activities, manufacturing, finances, and commercial prospects for the consumer's engagement. (Riasanow, et.al., 2021). The Industry 4.0 (I4.0) framework and its contributing digital technologies are shown in **figure 2**.

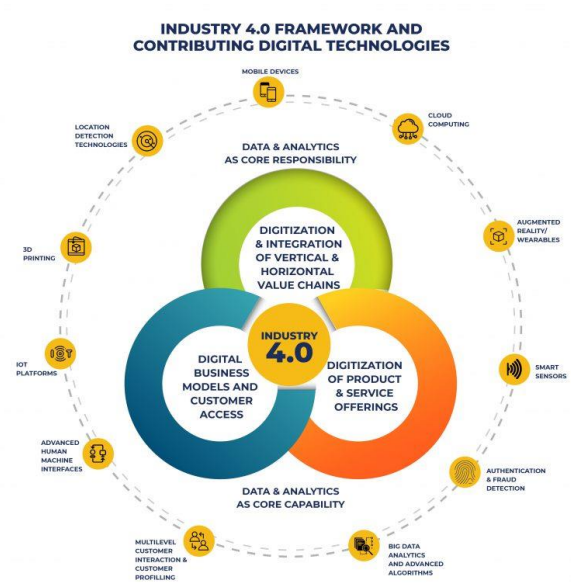


Fig. 2: I4.0 & Digital Technologies (Kenovy, 2024)
Source: created by the authors.

More effective administration of resources - Resources and knowledge are combined through the digitization process to create a set of managerial technologies. It combines corporate assets and lessens supplier duplication in place of scattered information and technologies. Software, records, and technology can all be combined as part of the digital transformation to create a single location that provides company insight. A division or operational unit of consumer electronics cannot be an element of digital transformation. It covers all elements of a corporation and creativity in processes and productivity amongst divisions. Each unit, from marketing and sales to accounting and the IT Suite, makes use of personally identifiable information (Nadkarni, et.al., 2021).

Understanding Customers through Information - Information about customers may be unlocked via information. Consumer electronics companies may develop an organization plan whose focus is further centred on the customer by becoming more acquainted with the consumers and their requirements. These conclusions may encourage corporate success by utilizing both organized data and unorganized information, such as metrics from social networks. Approaches can deliver personalized, individualized, and flexible material due to analytics (Brunetti, et.al.,2020).

Improved Customer Satisfaction - Digital change in the Consumer electronics may not exclusively increase employee efficiency but additionally give customers better, more natural encounters. This includes everything from messages on email to customer websites, electronic goods, along with the duration of the outreach to potential customers. Consumers possess strict requirements for what they do on the internet. Customers are accustomed to getting a huge selection, affordable rates, and quick service. Customer experience (CX) is an emerging front on which companies are competing. According to Gartner, over three quarters of businesses claim believe their main competitive advantage is the client experience (Boneva, 2018).

Foster Enhanced Communication - Digital transformation promotes an online culture by giving individuals the right resources that are suited to what they do. These instruments not only make it easier to work together, but they additionally assist the Consumer electronics organization as a whole advance digitally. **Figure 3** shows the digital transformation maturity model.

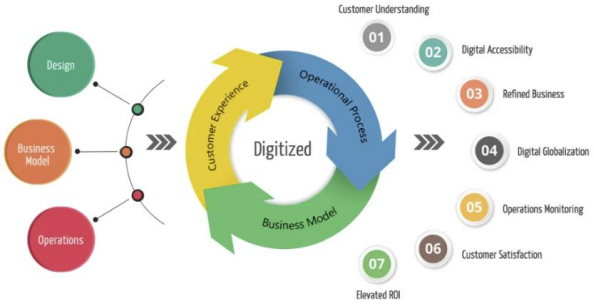


Fig. 3: Digital Transformation Maturity Model (NovelVista, 2024)
Source: created by the authors.

The change to a digital society is essential for Consumer electronics market to continue operating sustainably. It encourages teammates to upgrade their skills as well as grow digitally so they can profit from the shift to digital technologies (Kotarba, 2018).

Enhanced Agility - Organizations become nimbler because of digital change. Businesses can embrace CI (constant improvement) practices and enhance their responsiveness through a digital shift by learning from other sectors of programming. This creates a speedier environment for invention and adaptability besides opening the door to advancement (Fernanadez, et.al.,2021).

Increased output - The correct technological equipment combined with effective processes can increase performance. It enables teammates to operate with greater efficiency by eliminating tedious procedures and connecting information across the entire organization (Gobble, 2018)

2.2 DT Impact on Global Manufacturers

According to Reinartz, et.al., (2019), manufacturing has an enormous chance to increase effectiveness in operations, decrease expenses, and boost the consumer service because of the digital revolution. Increasing technological advancements and a growing need for processes that are better, more environmentally friendly, and informed by data are driving a significant transition within the manufacturing sector. This shift, also known as Industries 4.0, ushers in an additional phase of technological advancement; decision-making based on data, and automated intelligence. Manufacturers who want to stay relevant in a market that is shifting quickly must implement I4.0 techniques & practices (Vial, 2021). **Figure 4** illustrates the digital technologies and transformation within manufacturing.

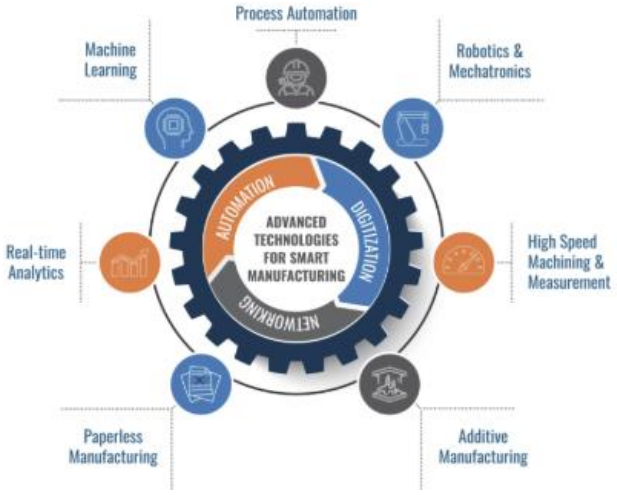


Figure: Digital Transformation and Manufacturing (Quest Global, 2024)

Manufacturers who can employ information and analysis to stimulate development and enhance the way they operate are going to prevail in a time when information is emerging as the new form of money (Travao, 2020). As it allows for the development of environmentally conscious and economically viable methods of manufacture, the digitization in manufacturing additionally represents a crucial option for tackling the worldwide problems caused by environmental degradation. It is impossible to overestimate the importance of technical developments in the electronic age of manufacturing. Manufacturing companies have become equipped to

gather and analyse enormous volumes of information, streamline procedures, and simplify processes because of advancements in fields like the machine intelligence (MI & AI), IoT, and cloud technology. As a result, producers have been able to increase productivity, cut expenses, and raise the calibre of what they produce and provide (Davidavski, 2018). Another major factor influencing the technological advancements of industry is increased competitiveness. Manufacturers find themselves under greater obligation to enhance their processes and provide distinctive and imaginative products and services because of an upsurge in worldwide rivalry. Manufacturers could distinguish their products from other companies, keep one step forward of their rivalries, and more effectively meet client requests by adopting technological advances. **Figure 5** provides an illustration of enterprise transformation with devices.



Fig. 5: Enterprise Transformation (WSO, 2025)
Source: created by the authors.

The requirement for technological change within the manufacturing sector is also being driven by emerging consumer needs and market conditions (Savastano, et.al., (2019). Customers are requesting increasingly individualized and customized offerings, along with more rapid turnaround times and higher-quality items (Liere, et.al.,2018). To comply with these requirements, manufacturers must employ technological advances which let businesses organize their companies more effectively, increase productivity, and satisfy client requests. Since the advent of the fourth industrial revolution and the widespread implementation of technological advances, the manufacturing business has experienced a considerable development. The correct technological advances, an atmosphere of acceptance, and an emphasis on information and analysis are necessary for successful execution in digitization within manufacturing industry. According to Verhoef, et.al., (2021), The term "industry 4.0" relates to what is known as the 4th industrial age, which is characterized by the incorporation of cutting-edge technology throughout the manufacturing process, including automation, the IoT and computational intelligence (AI), The proper implementation of these innovations is essential for manufacturing's digitization. Manufacturers might boost productivity, lower prices, while enhancing the general standard of what they sell by incorporating these innovations. Thus, it can be said that standard handling of information or improvement of processes techniques, technological change has an extremely adverse effect on manufacturing companies. The use of technological advances to use information from machinery transforms additional manufacturing operations (Guenzi, et.al.,2020).

2.3 Role of Digital Transformation on Sustainability among Global Manufacturers

The development of technological advancements in the past couple of decades has fuelled the growth of digitization in industries as well as society. According to Bican, et.al., (2020), Mobile, interpersonal, cloud computing, massive data sets, and IoT are examples of traditional technological advances. Secondary or newly developed technologies include 3D printing, wearable gadgets, augmented or virtual reality, AI, aerial vehicles and automation, and advanced learning computation. Traditional work practices, jobs, and company structures have been completely transformed by recent advances in technology. Organizations may have opportunities for providing innovative electronic goods and services, electronic company processes, or digital company structures in an environment which has become progressively digitized. Sustainable development represents an important subject for businesses to address to overcome fluctuations in markets brought on by globalization or unforeseen occurrences like the Covid-19 outbreak, as well as in accordance with emerging regulations regarding the environment and higher standards of excellence (Termeleva, 2022). Sustainability manufacture in manufacturing businesses refers to putting strategies into effect and starting initiatives that meet the organization's current demands and requirements simultaneously maintaining, improving, and protecting materials which are going to be needed in future generations. The use of environmentally friendly, cost-effective, economically reliable, and pleasant manufacturing methods that are beneficial to staff, neighbours, and consumers is another aspect of sustainable manufacturing. **Figure 6** provides a framework for integrated model of digital transformation and its impact on SDGs (Varriale, et.al., 2024). Sustainable practices are required to be used by all stakeholders associated with the chain of manufacturing and at every phase of the lifespan of an item to achieve the

sustainability goals. Manufacturing businesses might be forced to change the organizational frameworks, establishments, technology for production, and financial framework to achieve these objectives (Kunkel, et.al.,2020). These types of examples modifications often unable to take place without deliberate, integrated, and united attempts by everyone involved to intentionally and systematically tackle the issue, which can only be accomplished by progressively enhancing current technologies.

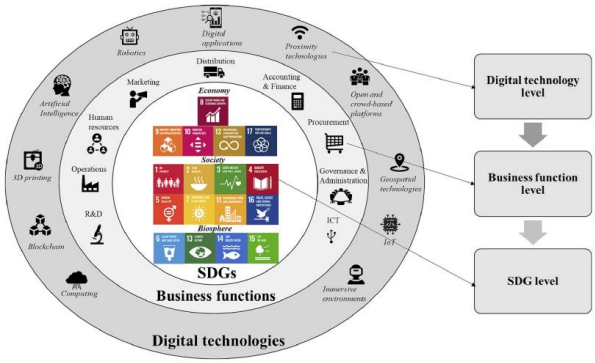


Fig. 6: Integrated Model for Digital Transformation Impact on Sustainability and Sustainable Development Goals (SDGs) (Varriale, et.al, 2024)
Source: created by the authors.

As it relates to society the surroundings, and the financial system, sustainability is a combination of a person's activity's environmental, social, and financial achievements towards the advantage of the current and future generations. Sustainability that extends outside ecological action includes protecting both social and economic sources (Pflaum, et.al., 2018). To be sustainable, one must priorities the welfare of people, safeguard essential resources, and reduce the quantity of debris produced by human beings. To achieve sustainability in the economy, sustained development must be pursued while protecting environmental and occupational assets. The concept of social sustainability places a heavy emphasis on personal and communal happiness which is a non-monetary form of capital. Achieving a sustainable environment entail promoting human well-being, protecting vital assets, and reducing wastes produced by human activities.

The concept of sustainability describes the triple bottom line (TBL) is used to describe each of the three elements of sustainability. TBL creates the equilibrium and harmony structure by giving the same importance to the three branches connecting environmental, social, and economic variables as shown in **figure 7**. The transition to sustainability & the decreasing of the ecological impact of manufacturing industries have been attributed with digital transition (Peng, et.al.,2022).

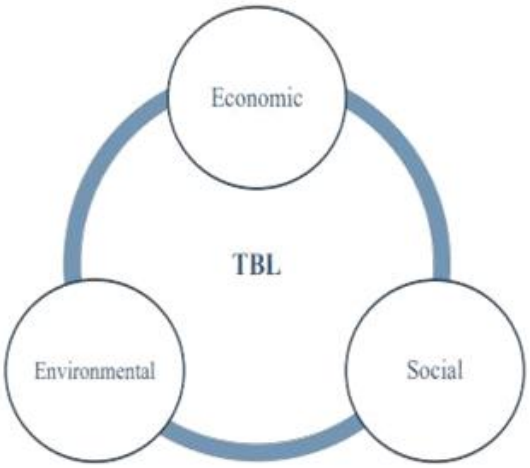


Fig. 7: TBL of Sustainability (Bach, et.al., 2018)
Source: created by the authors.

At numerous points in the manufacturing process, technological innovations can be utilized to trace the movement of products, components, and resources as well as utilize the information that is gathered for improved utilization of resources. Additional benefits of the digital shift include a reduction in greenhouse gases, an increase in manufacturing effectiveness, substantial resources savings, and environmental sustainability.

2.4 Impact of Sustainable Transformation on Consumer Electronics

On an annual basis, concerns regarding the product's sustainability grow among consumers. Based on Simon Kucher's 2022 International Sustainably Research, sustainability has been cited as 66% of customers as being among the most important five factors influencing a purchasing choice, compared to 50% for 2021. Furthermore, 75% of buyers worldwide believe that environmental responsibility is equally essential to individuals today as it had been before 2021 (Sausa, et.al., 2019). Customer electronics companies, marketers, and producers face specific difficulties by the evolution in behaviour among customers, particularly considering the numerous studies that keep coming out concerning the rising amounts of digital waste and its negative effects on the natural world. According to Voglsang, et.al., (2018), The post-use dumping process is being improved by the customer electronics sector, for example, by employing additional "closed loop" components. It appears probable that organizations will come up with devices in years to come which render it simpler for consumers to reuse all their parts. Reusing materials though, cannot serve as the only solution. To

effectively tackle the issue increasing electronic waste and improve sustainability, a multidimensional approach is required. The key to sustainability is possessing accurate data and utilizing it to guide decisions and actions, not merely choosing materials that are appropriate. It is so because the next phase of development will be driven by a combination of sustainability and technological advances, including technology facilitating sustainable development.

Organizations who implement a strong digital improvement plan to increase their efficiency and sustainability will prosper. For instance, a lot of businesses are starting to use the technology of digital twins for assessing and enhancing the robustness of their supply networks (Loonam, et.al.,2018). Erroneously distributing inventories may result in major consequences for both profitability and sustainability upon the preparation end. Companies may improve their understanding of the consumers whose goods they can supply and increase their capacity in responding rapidly to altering need by acquiring openness and insights from data. Every phase of the manufacturing network, from retailing to advertising, consumer assistance, will reap the long-term rewards of an approach that prioritizes digital.

By anticipating and promptly reacting to happenings within the manufacturing environment, improved understanding of supply chains enables consumer electronics companies, shops, and producers to develop strategies that are more environmentally friendly and risk-resilient. Electronics manufacturer groups may boost the process openness, work together as well as jointly develop using providers, acquire an early understanding of profitability, accelerate the path to marketplace, use purchasing authority to bring lower expenses, and avoid supply- chain interruptions in postponing new product introductions by employing a good lifecycle administration (PLM) structure like Centric PLM (Ganievich, et.al.,2021). According to Li (2020), Deloitte reports that 46% of buyers desire additional information concerning how to properly recycle or discard of obsolete goods. At the finish line of the lifespan of a good, companies may encourage the reuse or recycling of used components by developing cyclic supply networks. The ability to track is crucial for the effective recovery and usage of raw materials towards the conclusion of the lifespan of an item. Circle manufacturing processes can only be efficiently implemented when electronic devices are employed for tracking the use of essential components across the good's lifespan.

Any approach to sustainability must be built on reliable, current information concerning the supply chain. Making choices gets challenging for organizations without knowledge of the expenses, fees charged by suppliers, vendor problems, implications for the environment, recycling of material, and future logistics interruptions (Pappas, et.al.,2018). It's the responsibility of companies, sellers, and producers to act and adopt technological innovations which will generate more environmentally friendly goods as consumers become increasingly aware regarding environmental difficulties facing the market for consumer electronics.

2.5 Digital and Sustainable Information Impacting Manufacturers

According to Brown, et.al., (2019), Governments and major organizations have begun looking for solutions to the phenomenon of environmental degradation, the subject of sustainability has received more attention upon a worldwide basis. Despite knowing that the term "sustainability" is now commonly used to refer to various "green" industry practices, the manufacturing sector has the most relevance. Manufacturing activities consume a lot of electrical power and ingredients; thus, companies who adopt more sustainable practices may have an advantage over rivals in the competitive landscape. Manufacturing has long been interested in using sustainability to have an advantageous effect on people (Gigova, et.al.,2019). Organizations continue to be exploring for generations seeking methods to enhance their fundamental company processes while reducing consumption of resources. As a matter of reality, numerous businesses are implementing sustainability programmes to draw in fresh faces because youngsters place great importance on it. In the words of Deloitte, manufacturing procedures today consume about a quarter of the power available across the US or one third of the power throughout worldwide. Businesses which optimize their resource usage or think about utilizing renewable sources of energy may encourage sustainability and, possibly, cut expenses as the cost of energy rise globally (Dyatlov, et.al., 2019). More prominent manufacturers are making investments in directly generation, powering their manufacturing facilities with thermal engines, photovoltaic panels, and windmills. With lower prices and superior monitoring of the environment, technological advancement leads to increased oversight of quality, massive performance advantages, and improved goods. All aspects of production have shifted as a result, giving them significant edge over their competitors and altering the global economy. The way manufacturing companies' function is changing because of growing IT expenditure, which enables companies to work

more efficiently, reduce expenses, and meet increasing demands from customers for customization. **Figure 8** shows manufacturing intelligence & its application.



Fig. 8: Manufacturing Intelligence and Application (Saheb, S.H., 2024)
Source: created by the authors.

Improved Quality and Process Efficiency - Manufacturers may manufacture items of greater quality with more detectors, computerized testing, and superior management across the process of manufacturing (Feroz, et.al., 2021). Manufacturers may apply adjustments to every manufacturing process to lower mistakes and enhance procedures utilizing the idea of Pareto (information gained through artificial intelligence and machine learning). Organizations can eliminate mistakes made by humans in their manufacturing procedures through hyper automation. To enhance the way people, operate, hyper automation integrates computational intelligence (AI) and ML (Feroz, et.al., 2021).

Green Thinking - As the demands of consumers for eco-friendly practices grow, innovation continues to supply solutions. Machines that are controlled by AI are more efficient and use fewer resources. Improved effectiveness frequently encourages reduced resource usage as well. The ecosystem benefits greatly from reduced utilization of resources (Sebastian, et.al., 2020). A well-recognized digital transformation plan alters not solely the manufacturing procedure but also internal organizational procedures. Management for the manufacturing process, the supply chain, managing inventories, and other areas could profit from analytical modelling (Hydros, et.al.,2022). The latest technological architecture enables similarly instantaneous responses to market circumstances and request, just as actual time information is utilized to optimize production processes. Conventional manufacturing procedures are changed as the structure develops, and organizations that manufacture perform more effectively.

3 Research Methodology

3.1 Research Philosophy and Approach

The study uses interpretive research philosophy important for researching topic through a subjective point of view and the interpretive style of study here to gather insights in topic through decoding the human nature and human emotions and then get more sufficient data on thee the sustainable digital transformation of the global customer electronics brands (Newman, and Gough, 2020). The approach of the research is the thought process of the researchers and how they are going to conduct the project (Greening, 2019). The inductive process is important to research hypothesis from existing research theory, as it provide ideas to induce research assumptions and to get ideas on ways customer electronics transforms digitally to a sustainable brand (Mukherjee, 2019).

3.2 Research Design and Strategy

The design is the basic blueprint about how well the researchers will be conducting the project without any potential human errors. Studies have used the descriptive type of research design which is important for making proper designs for secondary type of data collection process (Mishra & Alok, 2022). The descriptive type of research design has here provided a more comprehensive and concise type of data and helped to build a more authentic research project by possibly measuring correctly all the trends of data in the market and hence have helped to get sufficient data on the issue of transformation of electronics brands mor digitally inclined and sustainable with time. The qualitative strategy is much more flexible to decode and much more of a content generator and helps to save a lot of time and money (Snyder, 2019).

The data collection process is the most important and difficult step where researcher finds proper ways on gathering all the important data and then analysing and at last trying to implement those data correctly into the fold of the research to improve the quality of the study (Zhang, et al, 2023). The secondary data collection process is low cost or almost free for the researchers and can gather ideas and insights about how the global consumer electronics brands are changing sustainably and digitally (Dodds, and Hess, 2020). The **inclusion and the exclusion criteria** of a research paper show how exactly researchers can make a perfect project without using too much irrelevant data or the data those are not updated recently (Gupta, and Gupta, 2022).

4 Data Analysis

Global customer electronics manufacturing is experiencing a Digital as well as Sustainable Transformation that can entail combining digital technologies and eco-friendly practices to innovation, develop productivity, and eco-friendliness in production, product design, and operations. In this data analysis section, for investigating studies on sustainable and digital transformation for the international manufacturers of customer electronics.

Theme 1: Impact of DT on Consumer Electronics:

The landscape of the software industry and technology is being completely improved by digital transformation, echoing its impact on the industry of consumer electronics (Christof, et.al, 2018). The technology of Software has been transformed by digital transformation in the same path that the electronics of consumers have been by including smart connectivity, features, and data-driven insights into everyday products. Cloud computing has been acquired throughout the software business because of digital transformation, helping easy cooperation, scalability, and as remote access. This can mimic the networked gadget movement in the electronics of consumers, where customers may control and keep an eye on devices from their smartphones. However, like how customer devices have developed in intuitiveness and usability, software applications have developed for embracing personalised experiences and user-centric design.

Table 1. Impact of Digital Transformation Key Research Areas

Source	Aim and Research Focus
Christof, E., et.al, 2018	**Aim -** To talk about how the software industry, as well as its technology, are being affected by digital transformation. **Research Focus** – Digital Transformation has drastically changed the landscape of the software business and technology, mirroring its effects on the consumer electronics industry.
Pousttchi, K., et.al, 2019.	**Aim -** To establish a theoretical framework that can aid in the future exploration of possible cause- and-effect relations between digital technologies employment and their effects on the organisation along the three key dimensions. **Research Focus** – The various fundamental technological effects that the digital transformation has had on consumer electronics are evidence of the significant changes brought about by the paradigm movement.
Liu, R., et.al, 2019	**Aim -** To identify the environmental effects of digitalization, with a focus on the effects of nonenergy. **Research Focus** – Customer electronics are significantly impacted by digital transformation, with significant environmental and sustainability issues that can reflect broader concerns because of this shift in fundamentals.

Source: created by the authors.

On the other hand, software technology's utilisation of AI and Big Data for strategic resonates of decision-making with the customer electronics emphasis in the industry on data collecting as well as analysis. **Table 1** summarises the impact of DT key research areas. In essence, the software sector's evaluation and the effect of the DT of consumer electronics are the same since both are charged by connectivity, innovation, and experiences for users. The huge changes brought about by the paradigm movement may be noticed in the different primary technical effect varieties that the digital transformation has had on customer electronics (Pousttchi, et.al., 2019). However, consumer electronics products now have new capabilities and features thanks to DT. This is the same as the industry of software emphasises making innovative software as well as solutions that take advantage of technologies of cutting-edge such as IoT, automation, and AI. Similarly, DT puts a powerful emphasis on integrating platforms of software and information sources, which results in efficient operations and increased interfaces of users.

Customer electronics can collect user data for improving performance and personalised experiences, just as data analytics of digital transformation uses for drawing insights. The necessity of data in setting up plans and creating decisions is featured in this convergence. Consumer technologies are made to be user-friendly and intuitive thanks to digital transformation, which may encourage an approach that is user centric. The experience of the user is given the most priority by the technology of software, which aims for tailored interactions and user-friendly interfaces. The effectiveness of digital transformation on customer electronics is reflected by the sector's quest for software for functional efficiency through mechanisation, which reduces the costs of manual labour and increases productivity.

Customer electronics are notably affected by DT, with substantial sustainability and environmental issues that can reflect wider worries following this principal shift (Liu, et.al., 2019). As appliances become hugely complicated and feature-filled, consumer electronics' rapid development brought on by DT repeatedly results in enhancing the consumption of resources, including energy and raw materials. Similarly, the extension of the software sector can necessitate notable expenditures of energy for computing infrastructure and data centres. Because of the digital transition and the fast pace of technology in consumer electronics, there is an enhancement in the waste of electronics. Like the software and hardware industries, the software sector can contribute to the burden of the environment by producing trash of electronic. While DT develops operations, it is important for considering the energy required to run digital devices, like customer electronics. This is consistent with the demanding activities utilised throughout the software industry, such as cloud computing and data processing. Digital transformation and consumer electronics both affect the lifecycle, from manufacture to utilise to disposal. Both fields need sustainable practices, like the long-lasting design of products, lower energy utilisation, and reprocessing promotion.

Theme 2: Digital transformation Impact on Global Manufacturers:

According to Gurbaxani and Dunkle (2019), international manufacturers are taking a proactive posture called "Gearing Up for Successful Digital Transformation" for managing the impacts of DT. Industries of manufacturing, among others, are encountering a digital transition, and industries are realising they should modify their procedures, business plans, and infrastructure, for staying competitive. Manufacturers are using digital technologies as IoT, automation, and data analytics, for improving SC, optimising manufacturing, and offering individualised consumer experiences.

Table 2. DT Impact on Global Manufacturers

Source	Aim and Research Focus
Gurbaxani, and Dunkle, D., 2019.	**Aim -** Requirement of a framework for guiding their transformation as well as assessing the digital journey at the above time. **Research Focus** – International manufacturers are preparing for a successful DT by adopting a proactive strategy dubbed "Gearing Up for Successful Digital Transformation" to manage the effects of this change.
Appio, FP., et.al, 2021	**Aim -** To create a framework for examining how the digital transition impacts innovation. **Research Focus** – The significant effects of DT on international manufacturers can be examined in "A Synthesis of Current Research and a Program for Future Studies."
Llopis, A., et.al, 2021	**Aim -** To examine how the upcoming DT would impact the performance of company models and the satisfaction of different actors. **Research Focus** – The impact of DT on global production can be best seen in the automotive sector. Automation, IoT, and other technological advancements are driving a paradigm shift in the automobile sector.

Source: created by the authors.

Table 2. summarises DT impact. This strategy, which can entail thorough operations, as well as a business model, revamp, is compatible with the encompassing objective of preparing for effective DT. Manufacturers may enhance operational effectiveness, responsiveness to the need of the market, and quality of products by taking DT

In a fast-changing digital economy, where industries that innovate and adapt can be best positioned for thriving among the disruptive forces sectors of transforming globally, the proactive approach of "gearing up" features the strategic vital of staying ahead. Studies examines the digital transformation's substantial implications on global manufacturers. It can clarify how firms are interchanging their practices of innovation management in reaction to digital disruption by incorporating current findings (Appio, et.al., 2018). This synthesis can highlight how supply chains, traditional procedures of production, and consumer contacts have interchanged because of the digital transformation's effect on global manufacturers. It can highlight how urgent it can be for manufacturers for adopting cutting-edge approaches that are also adaptable to the digital era and will develop their sustainability as well as competitiveness. It can open the door for a huge thorough examination of how digital transformation impacts the management of innovation throughout manufacturing contexts.

This agenda for the next studies is directed in the summary. Examining the fusion of cutting-edge

technology, updating business structures, and the dynamic interaction between digitalisation and innovation are each part of this. In the end, the synthesis can emphasis how important management of innovation is to steer international manufacturers through the complex digital transformation terrain.

The automotive industry is a key example of how DT has impacted international manufacturing (Llopis-Albert, et.al., 2021). Technological improvements such as AI, IoT, and automation are reasoning a paradigm movement throughout the automotive industry. Manufacturers are utilising digital technologies in the manufacturing, development, and customer interfaces of vehicles. This transition is exemplified by autonomous driving, connected cars, and electric vehicles, which can alter how cars are created, designed, and used. Supply chains, as well as distribution networks, are also utilising digital platforms for optimising operations, enhancing efficiency, and cutting costs. This change is compatible with the broader impacts on global manufacturing, underscoring the requirements for enterprises for changing to the digital era. The appropriation of DT by the industry of automobile can serve as a reminder of the requirements for manufacturers throughout all industries for innovating, be flexible, and assume new models of business for prospering in a technologically advanced and connected world.

Theme 3: Role of DT on Sustainability

The report of past, present, as well as future barriers to DT in Manufacturing can look at the disadvantages that have stopped the adoption of digital transformation throughout the manufacturing industry (Jones, et.al., 2021). This analysis covers past challenges or difficulties, present problems, and projected challenges throughout the future. The review of DT's role in sustainability throughout global manufacturers provides insightful data about potential challenges manufacturers may encounter when attempting for combining sustainable practices with efforts of digital transformation. It may clarify how past, present, as well as future obstacles might impact how company sustainability objectives and strategy are aligned. Manufacturers might proactively find issues that can improve when attempting for achieving acceptable outcomes in digital transformation by accepting contemporary and historical barriers. This full analysis can assist in formulating plans for getting above roadblocks and transparent the path for the effective assumption of sustainable practices and DT throughout the manufacturing world. The study examines the part that green HRM strategies may play manufacturing sustainability (Yong, et.al., 2020).

Table 3. Role of DT on Sustainability

Source	Aim and Research Focus
Jones, M.D., et.al, 2021	**Aim -** To investigate the effect of COVID-19 on DT barriers and propose a strategic approach. **Research Focus** – The analysis examines the constraints that have prevented the manufacturing sector from adopting DT.
Yong, J., et.al, 2020	**Aim -** To evaluate the effect of green HRM on manufacturing sustainability. **Research Focus** – The study can look at how green HRM practices might contribute to manufacturing sustainability. This empirical study can investigate the connection between HRM practices and outcomes that promote environmental responsibility.
Savastano, M., et.al, 2019	**Aim -** Mapping and developing research on manufacturing's digital transition. **Research Focus** – Impact of Context on Industrial. The processes brought about by the digital manufacturing revolution looks at how the manufacturing processes may be impacted.

Source: created by the authors.

Table 3. summarises role of digital transformation. This empirical study can investigate the relationship between HRM practices and sustainable results that may emphasis the responsibility for the environment

The digital transformation role in sustainability throughout international manufacturers can serve as a motivation for green HRM integration. Through enhanced analytics of data, efficiency, and communication, manufacturing may support the sustainable practice's adoption as it can embrace digital transformation. The workforce strategies integration with sustainability goals is braced by DT, which develops the willingness to monitor and control projects of green HRM. It may develop training for green practices, promote an environmentally conscious culture and expedite operations. The research on green HRM's contribution to continuous fits into a greater framework of how DT impacts and speeds up acceptable practices, particularly throughout the manufacturing industry.

Contextual effects on industrial Processes brought by manufacturing's digital transformation, examine how the digital manufacturing revolt can affect the industrial processes of manufacturing (Savastano, et.al., 2019). This paper may explore the numerous alterations and modifications brought on by

digitalisation throughout the situation of manufacturing. The systematic review can help in comprehending how digital transformation impacts sustainability capabilities and is connected to Digital transformation's role in Sustainability in international manufacturers. It may analyse how changes to processes of business brought about by digitalisation may have a direct effect on practices of sustainability along with waste reduction, resource efficiency, and environmentally friendly manufacturing. Manufacturers can strategically equal their goals of sustainability with interchanging industrial processes by concerning the contextual impacts of digital transformation. The evaluation may emphasis the notable of taking continuous considerations into account in the wider digital transformation context, powering the capacity of global manufacturers for driving environmentally friendly exercises and advancing a huge sustainable future throughout the sector of manufacturing.

Theme 4: Impact of Sustainable Transformation on Consumer Electronics

Digital transformation as well as Environmental Sustainability, a research agenda and review can explore the environmental sustainability and digital transformation intersection (Feroz, et.al., 2021). This review can assess how digital advancements affect the efforts of sustainability throughout different sectors, which includes customer electronics. However, relating to the effect of sustainable transformation on customer electronics might discard light on how digital transformation affects the eco-friendliness of electronics of consumers. It might investigate how digital technologies are utilised for enhancing the recyclability, energy efficiency, and sustainability of the lifecycle of electronic devices.

Table 4. summarises the impact of sustainable transformation on consumer electronics sectors. On the other hand, by interpreting the digital transformation role of advancing the sustainability of the environment in customer electronics, this research can guide policymakers and manufacturers toward greater ecologically aware practices

Table 4. Impact of Sustainable Transformation on Consumer Electronics Sector

Source	Aim and Research Focus
Feroz, A,K., et.al, 2021	**Aim -** To analyses digital transformation's disturbance for the advancement of environmental sustainability. **Research Focus** – The nexus of environmental sustainability and digital transformation can be explored through a research agenda and review of the literature.
Gomez, A.M., et.al, 2021	**Aim –** To review earlier study findings on how sustainability and digital transformation the corporate level is mutually related. **Research Focus** – The use of DT as a strategy for achieving sustainability can show how employing digital technologies may be crucial to achieving sustainability goals.
Wang, C.H, 2019	**Aim –** To empirically make and evaluate the theoretical model that can examine the effect of organisational green culture or OGC on competitive advantage and green performance. **Research Focus** – Studying the effects of organisational green culture on competitive advantage and environmental performance examines how an organization's green culture affects both sustainability and market competitiveness.

Source: created by the authors.

It might potentially feature strategies for decreasing electronic waste, promoting greener production methods, and optimising resource utilization, thus providing broader goals of sustainability in the industry of consumer electronics. As per the view of Gomez-Trujillo and Gonzalez-Peroz (2021), digital transformations as a plan for reaching sustainability can demonstrate how using digital technology may be important to reaching objectives on sustainability.

This idea can emphasis how incorporating digital developments in customer electronics drives eco-friendliness throughout the context of the effect of Sustainable Transformation on customer electronics.

Energy-efficient manufacturing, smart product design, and data-driven recycling activities can be made feasible by digital transformation. Customer electronics have fewer environmental footprints because of those methods. Users of attached devices can also keep an eye on and control their energy utilisation, which develops sustainability throughout daily life. The study on how organisational green culture can influence competitive advantage and green performance looks at the impacts of an organisation's green culture on the performance of sustainability as well as market competitiveness (Wang, 2019). This idea can emphasis that a powerful green culture inside customer electronics companies may encourage sustainable transformation in the context of the effect of sustainable transformation on customer electronics. A consumer business on electronics may innovate in

eco-friendly goods design, ethical disposal practices, and energy-efficient production, by encouraging a culture of environmental responsibility.

Theme 5: Ways in which digital and sustainable information can improve its impact on the global manufacturing industry of consumer electronics:

Studies analysed an emerging agenda on Research aims for identifying the major areas of research where I4.0 as well as sustainable practices converge (Machado, et.al., 2020). However, in this regard, looking into ways in which sustainable and digital information may develop its effect on the international manufacturing industry of customer electronics can reveal paths in which digital technologies can support waste reduction, eco-friendly production, and resource improvement in line with sustainable agenda on manufacturing. This research assists in improving strategies that increase the positive effect of both movements on the industry's global efforts on sustainability. The disruption of sustainable operation and production management produced by the pandemic has featured the necessity of resilience as well as adaptability (Kumar, et.al., 2020). Investigating paths in which sustainable and digital information may develop its effect on the international industry of manufacturing customer electronics can shed brightness on how digital technologies can enable predictive maintenance, remote operations, and eco-design, increasing efficiency and sustainability.

Through addressing the potential for combining sustainable and digital tactics that strengthen the customer electronics industry's flexibility while advancing the goals of the environment, such investigation is in line with tackling the problems brought on by the epidemic. The goal of the critical assessment as well as research agenda is to thoroughly examine the subtleties of the digital economy of Asia (Li, et.al., 2020). However, examining paths in which sustainable and digital information may develop its impact on the global industry of manufacturing customer electronics in tandem can show how fusing sustainable practices and digital tools develops lifecycle sustainability, resource efficiency, and eco-friendly innovations for the manufacturing of customer electronics.

Table 5. Digital and Sustainable Information Ways for Improvement on Consumer Electronics Manufacturers

Source	Aim and Research Focus
Machado, C.G., et.al, 2020	**Aim –** To systematically review the integration of Industry 4.0 with sustainable manufacturing. **Research Focus** – Finding the key research areas where I4.0 and sustainable practices overlap is the goal of the study; while supporting the implementation of I4.0 agenda around aspects of sustainable business models; sustainable & circular production systems; sustainable SC; and sustainable product designs.
Kumar, A., et.al, 2020	**Aim –** To address disruption of SC and post-pandemic sustainable production problems. **Research Focus** – The COVID-19 outbreak has highlighted the need for resilience as well as adaptability in the management of sustainable operations and production.
Li, K., et.al, 2020	**Aim –** To evaluate the background and foundations of high-tech development significance in Asia and contribution to removal of historical barriers in traditional businesses. **Research Focus** – Digital economy in Asia involved revamping business process through tech-innovation, govt. policies for growth, and digital entrepreneurship. With some of the focus on issues surrounded through impact of events such as that of global pandemic.

Source: created by the authors.

Table 5. summarises the digital and sustainable information ways for improvement on manufacturers. While investigating this synergy, the research methods on advances that can integrate digitalisation with sustainability for a huge sustainable and effective international industry of consumer electronics and understanding of the digital economy of Asia. It has been concluded from the above analysis that it is clear how digital and sustainability transformation interact with the manufacturing sector in the world, especially consumer electronics. The shift towards digitalisation develops waste reduction, eco-friendly technologies, as well as resource efficiency. However, for ensuring a prosperous and sustainable future, issues of energy usage and waste of electronics should be resolved

Key Research Findings

The software industry's landscape has considerably developed because of digital transformation, as it has impacted the customer electronics industry (Christof, et.al, 2018). The software has assumed cloud computing for

cooperation, just as customer devices have developed with connection, smart features, and data insights, and Big Data and AI are in line with improvements in data-driven customer electronics. Customer electronics have been notably affected by digital transformation, providing them with new capabilities (Pousttchi, et.al., 2019). Like this, the sector of software puts a powerful emphasis on solutions of cutting-edge that utilise automation, IoT, and AI. Both businesses place a high priority on customer-friendly digital transformation and operations. Consumer electronics are hugely affected by digital transformation, which can lead to enhanced consumption of resources and electrical waste because of fast technological developments (Liu, et al., 2019). The expansion of the industry of software can necessitate a notable amount of energy to compute infrastructure.

Global manufacturers are utilising a proactive approach, gearing up for effective digital transformation, for dealing with the impacts of the digital transition (Gurbaxani & Dunkle, 2019). This strategy can reflect the urgent requirements for maintaining competitiveness throughout a fast-evolving international market by joining digital technologies such as the Internet of Things, and automation, for optimising supply chains and improving the quality of products. As per the view of

The impacts of DT on global manufacturers may be clarified by a combination of managing research and a program for the next study, featuring the crucial function of management of innovation in navigating this composite environment (Appio, et.al., 2018). The sector of the automobile can serve as an example of how international manufacturing, business models, and supply chains are interchanging because of DT, which can include loT and AI (Llopis-Albert, et al., 2021). The paper on barriers to DT through manufacturing looks at challenges throughout time and offers suggestions to integrate sustainability into the procedure for effective results (Jones, et.al., 2021). Other studies examine how green HRM may contribute to viable manufacturing (Yong, et.al., 2020). It may examine how sustainability and HRM are interrelated, with the support of digital transformation. The study can evaluate how the digital revolution has impacted the procedures of manufacturing and how that has impacted sustainability (Savastano, et al., 2019). It may emphasis how important it is, in the conditions of the digital revolution, for coordinating sustainability objectives with the evolving process of the industry.

These studies may investigate the relationship between digital change and environmental sustainability (Feroz, et.al., 2021). The evaluation can evaluate how digital innovations are impacting sustainability throughout industries while connecting them to how sustainable interchange is impacting customer electronics for revealing eco-friendly practices. Studies examines an example of how integrating technology into customer electronics can promote energy efficiency, and eco-friendliness, increasing sustainable practices, digital transformations can be a technique to achieve sustainability (Gomez-Trujillo & Gonzalez-Perez (2021). Study shows improving an eco-conscious culture may lead to sustainable alteration in the consumer sector by analysing how an organization's green culture impacts sustainability performance as well as competitiveness (Wang, 2019).

I4.0 as well as sustainability have overlaps of research that can be identified throughout the study on viable manufacturing (Machado, et.al., 2020). However, investigating how digital information can improve sustainability throughout the production of customer electronics internationally reveals efficient processes for the reduction of waste and ecologically friendly manufacturing. The pandemic interruption features the necessity of adaptation. Investigating how digital and sustainable information impacts the production of customer electronics internationally can demonstrate how digital technologies develop sustainability and productivity while resolving problems brought on by the epidemic (Kumar, et.al., 2020). The research agenda, analysis, and focus on the digital economy of Asia. The intersection of digitalisation and sustainability for a greener sector can be highlighted by investigating how sustainable and digital information impacts international customer electronics manufacturing (Li, et al., 2020).

5 Conclusions and Future Research

The program entails combining cutting-edge electronics technology into the production and operations of customer electronics manufacturers globally to make sure lengthy sustainability. It seeks to enhance productivity, lessen environmental effects, and sculpt a business with a more accountable future. The entire study has been fulfilled with the aim that is for examining how international producers of customer electronics are going through both sustainable and digital change. It is both advantageous and necessary for the global consumer manufacturing industry of electronics to embark on a fully sustainable and digital transition. The utilisation of digital tools and ecologically responsible practices becomes important as companies continue to improve quickly thanks to breakthroughs in technology (Albukhitan, 2020). However, managing the changes

in results throughout organisations will be challenging during this shift. The cornerstone of an effective digital transformation is successful change management. However, for completing the process, new technologies should be adopted and a culture of adaption as well as innovation should be fostered. Staff and groups in the organisation need to be guided and empowered for navigating the interchanges brought about by digitalisation, even if there can be uncertainty, resistance, or even fear, a regular change management approach may lessen resistance and promise a more perfect transition.

On the other hand, the DT scope can encompass all internal processes of the organisation in addition to the process of manufacturing. Every aspect, from directory control to management of the supply chain, stands to profit from the analytical modelling application and usage of real-time data. Modern technical agility of architecture can provide fast answers to interchanges throughout the market and client requirements, developing production procedures and entire efficiency. The old process of industry endures significant changes throughout this changing environment (Al-Ababneh, 2020). Industries are prepared to control with better productivity, effectiveness, and responsiveness as the changes in the framework. Sustainability and digitalisation support capital efficiency, environmental-friendly tools, and waste deduction are natural derivations of this paradigm shift.

While digitalisation has the potential to decrease waste and encourage environmentally friendly solutions, some challenges may not be disregarded due to the explosive development of electronic gadgets. Any endeavour at continuous transformation should focus on problems like electronic waste management, energy utilisation, and the raw material's ethical sourcing. It is important to strike a balance between environmental stewardship and technological advancement to guarantee a sustainable and effective future. The risks are mainly great in the consumer electronics area. The business can determine international consumer patterns and resource utilisation in addition to affecting how society can function. It is necessary to have a comprehensive approach that may consider the broader influence on society and the environment and the product lifespan. Collaboration between decision-makers, business executives, and customers is necessary (Dodds and Hess, 2020).

5.1 Research Recommendations

Holistic Approach to Sustainable and Digital Transformation - A comprehensive strategy is needed for the customer integration of the electronics industry's sustainability and electrical technology. Manufacturers must form marketing cross-functional teams, the technology of the supply chain, and continuous expertise (Bican and Brem, 2020). These groups may work together to improve plans to incorporate environmentally friendly procedures for design aspects of product and disposal, resulting in a thorough makeover.

Research as well as Innovation Collaboration - Universities, businesses, as well as research organisations must work together for solving the benefits and problems that are brought about by sustainability and DT. Business organisations and governments may set up funds and grant efforts for supporting research projects aimed at making novel approaches to waste deduction, environment-friendly materials, and fruitful manufacturing throughout the customer electronics industry (Mugge, et al., 2020).

Regulations and Standards of Industry - For promoting sustainable practices throughout the consumer electronics business, industry regulations, and standards might be improved and enforced by several policymakers. These needs can include things such as restrictions on energy utilisation, e-waste management, as well as transparency of the supply chain (Savastano, et al., 2019). However, to create policies that can be both enforceable and effective, industry players, governments, and environmental organisations should work together.

Ethical Sourcing and Transparency of SC - Manufacturers must prioritise transparency of supply chains by implementing digital tools such as blockchain to follow the provenance of raw components and materials. The detrimental impacts of the extraction of resources and manufacturing on the society and environment may be decreased by cooperating with suppliers for ensuring practices of ethical sources (Yu, et al., 2021).

Workforce Training and Skills Development - Manufacturers must partner with institutions of education to improve training programs that give the workforce important digital skills and sustainable awareness to navigate digital transformation while promising sustainable practices. Collaboration between academia and business may make it easier to make courses that reach the sector's changing requirements (Machado, et al., 2020).

Circular Integration of Economy - To achieve the circular economy's (CE) concept, cooperation between customer electronics recycling and producer businesses is important. Manufacturers as well as

recycling businesses may work together to make products that are simpler for deconstruction and recycling (Mergel, et al., 2019). Governments may promote cooperation by offering tax breaks or economic aid to projects on businesses pursuing CE.

Consumer Engagement and Education - For the educating purpose, the public about the bad environmental impacts of electronics consumption and the benefits of choosing sustainable products, producers must work in conjunction with customer advocacy businesses and the media. Projects and campaigns of Joint awareness may give customers the power to create educated decisions, which will enhance demand for environmentally friendly products (Liu, et al., 2019).

International Alliances and Partnerships - Global cooperation may hasten sustainable production techniques implementation in customer electronics. However, for sharing best practices, findings on research, as well as creative solutions, manufacturers could join forces through alliances. Governments may aid international cooperation knowledge and technology promotion (Nadkarni and Prügl, 2021).

Innovation Hubs as well as Incubators - In the customer electronics sector, building innovation hubs as well as incubators with prominence on sustainable technology encourages cooperation between existing manufacturers, start-ups, researchers, and investors. These centres provide tools, guidance, and funding to hasten the adoption and creation of environmentally advantageous innovations (Peng and Tao, 2022).

Monitoring and Evaluation - Establishing frameworks to track and assess the development of the project for digital and sustainable transformation must involve collaboration between businesses, governments, and organisations of trade. Standardised criteria that can assess the environmental impact, resource productivity, and technical advancement may be manufactured through collective initiatives (Pousttchi, et al., 2019).

5.2 Conclusions from Research Objectives

The consolidation of cutting-edge technologies as well as ecologically responsible practices in the manufacture of customer electronics on an international scale is well-known as a digital and viable transformation. Change management is important for steering industries through uncertainty and resistance and empowering a flat transition to sustainability as well as digitalisation as the sector improves.

The **first objective**, DT has had a huge effect on the sector of software like its influence on customer electronics. Networking, smart features, AI, and cloud computing have reformed both industries. A challenge faced by the energy-consuming software industry is the effect of the digital transformation of customer electronics, which increases worries about enhanced consumption of resources and electrical misuse because of fast technological developments (Christof, et.al, 2018).

The **second objective**, to effectively navigate its impacts, global manufacturers are strongly accepting DT. This plan aims to develop supply chains and the quality of the product while addressing the need for competitiveness throughout a market that is continually interchanging (Llopis-Albert, et al., 2021). The impacts of DT on manufacturing may be better appreciated by combining the management of research as well as innovation programs. The car industry reveals the revolution in international manufacturing, models of business, and SC brought on by electrical transformation, including integration of AI and IoT.

The **third objective**, the article has discussed the temporal issues facing the transition of digital manufacturing and suggested approaches to uniting sustainability. It focuses on how digitally authorised sustainable manufacturing and HRM are related (Savastano, et al., 2019). It features the necessity of coordinating processes of changing sustainability objectives throughout this transformative period by examining the digital revolution's implications on industry practices as well as sustainability.

The **fourth objective**, analysing the relationship between environmental sustainability and digital transformation is the key goal of the entire study agenda. It can evaluate the effect of digital proceeds on sustainability throughout industries and examine how they specifically impact eco-friendly practices throughout customer electronics (Wang, 2019). The study promotes DT to sustainability by displaying examples of the integration of technology for energy efficiency and sustainable friendliness.

The **fifth objective**, Sustainability and Industry 4.0 have synergies, on feasible manufacturing. However, examining digital distribution to develop the production of customer electronics internationally indicates environmentally friendly procedures. The pandemic can emphasise adaptation values by showing how digital-sustainable integration can address different problems (Li, et al., 2020). Research can focus on digitalisation's greener convergence and sustainability in international electronics manufacturing, with importance on the digital economy in Asia.

5.3 Limitations and Future Research

Secondary data has some limits even though it gives useful insights into the sustainable and digital transition of the international customer electronics industry. On the other hand, the sources of secondary could not be as accurate as the primary ones, resulting in dated or inaccurate information (Brown and Brown, 2019). The relevance of the information can be affected if the environment in which it was affected is different from the study goals. Disparities in the collection techniques of data among sources may produce accurate analysis huge difficulty. Future research may make utilisation of primary collection techniques of data to overcome those restrictions. Surveys, case studies, and interviews may offer personalised and up-to-date insights from main organisation players. Primary data may give nuanced viewpoints on the challenges, plans, and sustainable and digital transformation results. It can disclose covert obstacles, main elements of success, and new techniques (Bican and Brem, 2020). By including direct, in-the-moment occurrences, this method would raise the research's applicability and credibility and allow for an extensive comprehension of the difficulty associated with the customer's journey in the electronics industry toward sustainable as well as digital transformation.

Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the author(s) utilized artificial intelligence (AI) technologies solely for the purpose of linguistic refinement and grammatical correction. Following the application of these tools, the author(s) comprehensively reviewed, verified, and edited the resulting text. The author(s) maintain full accountability and responsibility for the accuracy, integrity, and final content of the publication.

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