Review

Sustainable Cyber-Physical Production Systems in Big Data-Driven Smart Urban Economy: A Systematic Literature Review

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Abstract: In this article, we cumulate previous research findings indicating that cyber-physical production systems bring about operations shaping social sustainability performance technologically. We contribute to the literature on sustainable cyber-physical production systems by showing that the technological and operations management features of cyber-physical systems constitute the components of data-driven sustainable smart manufacturing. Throughout September 2020, we performed a quantitative literature review of the Web of Science, Scopus, and ProQuest databases, with search terms including "sustainable industrial value creation", "cyber-physical production systems", "sustainable smart manufacturing", "smart economy", "industrial big data analytics", "sustainable Internet of Things", and "sustainable Industry 4.0". As we inspected research published only in 2019 and 2020, only 323 articles satisfied the eligibility criteria. By eliminating controversial findings, outcomes unsubstantiated by replication, too imprecise material, or having similar titles, we decided upon 119, generally empirical, sources. Future research should investigate whether Industry 4.0-based manufacturing technologies can ensure the sustainability of big data-driven production systems by use of Internet of Things sensing networks and deep learning-assisted smart process planning.

Keywords: cyber-physical production system; sustainable smart manufacturing; smart economy; sustainable industrial value creation; Internet of Things; industrial big data analytics

1. Introduction

The objective of our systematic review is to analyze the lately published literature on sustainable cyber-physical production systems and synthesize the interconnected insights on big data-driven smart urban economy. By inspecting the most relevant (the Web of Science, Scopus, and ProQuest) and recent (2019–2020) sources, we have endeavored to prove that, in Industry 4.0, big data-driven technologies assist in the adoption of a cleaner production approach and in the advancement of sustainable smart manufacturing. The actuality and novelty of the current research are configured by paying attention to a hot emerging topic, that is, sustainable cyber-physical production systems. The research problem developed at full length of the systematic review is whether sustainable smart manufacturing platforms can be networked to assimilate the value chain throughout businesses and constitute a groundbreaking industrial form assisted by cognitive decision-making algorithms.

In this research, we cumulate previously published findings clarifying that, by use of Internet of Things-based manufacturing systems, industrial big data and knowledge distributed throughout diverse lifecycle management branches can be decisively enabled. Our main aim is to indicate that implementation of Internet of Things sensing networks,

real-time big data analytics, cyber-physical production systems, and artificial intelligence-based decision-making algorithms improve logistics processes. We contribute to the outstanding literature on sustainable cyber-physical production systems by showing that Industry 4.0 wireless networks stimulate businesses to set up a consonance between the economic feasibility of their decisions and low-carbon effects. We want to elucidate whether industrial big data analytics, deep learning-assisted smart process planning, sustainable product lifecycle management, and cognitive decision-making algorithms can assist throughout the decarbonization process by use of digital technologies.

2. Methodology

We conducted a systematic review of first-rate literature on sustainable cyber-physical production systems in big data-driven smart urban economy by adopting Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines, with the following inclusion criteria: (i) being an original empirical research or review article; (ii) publications indexed in the Web of Science, Scopus, and ProQuest databases; (iii) particular search terms covered; (iv) written in English; and (v) publication date between 2019 and 2020. Publications were excluded from our analysis if they were (i) books, (ii) conference proceedings, and (iii) editorial materials. We employed the Systematic Review Data Repository (SRDR), a software program for the gathering, processing, and inspection of data for our research. The quality of the selected scholarly sources was assessed by employing the Mixed Method Appraisal Tool. Deriving and analyzing publicly accessible files (academic articles) as evidence, no institutional ethics approval was needed before starting the systematic review.

Throughout September 2020, we performed a quantitative literature review of the Web of Science, Scopus, and ProQuest databases, with search terms including "sustainable industrial value creation", "cyber-physical production systems", "sustainable smart manufacturing", "smart economy", "industrial big data analytics", "sustainable Internet of Things", and "sustainable Industry 4.0". As we inspected research published only in 2019 and 2020, only 323 articles satisfied the eligibility criteria. By eliminating controversial findings, outcomes unsubstantiated by replication, too imprecise material, or having similar titles, we decided upon 119, generally empirical, sources (Table 1).

Table 1. Topics and types of paper identified and selected.

Topic	Identified	Selected
sustainable industrial value creation	39	11
cyber-physical production systems	78	34
sustainable smart manufacturing	54	24
smart economy	37	11
industrial big data analytics	35	10
sustainable Internet of Things	42	15
sustainable Industry 4.0	38	14
Type of paper		
original research	275	107
review	25	12
book	4	0
conference proceedings	11	0
editorial	8	0

Source: Processed by the authors. Some topics overlap.

3. Sustainable Industrial Value Creation in Data-Driven Sustainable Smart Manufacturing

The articulation of a data-driven digitalized production, where social sustainability characteristics are handled proactively [1–9], can generate value throughout Internet of Things-based real-time manufacturing logistics. Functionalities can improve operations that are pivotal to data-driven sustainable smart manufacturing. Social sustainability undertakings cover large-scale consequences of production mechanisms and manufactured goods. Cyber-physical production systems bring about operations shaping social sustainability performance technologically. Social sustainability, cyber-physical production systems, and performance assessment articulate cutting-edge manufacturing processes. With the aim of configuring smart and sustainable spaces, cyber-physical systems articulate computing, networking, and process monitoring technologies that are transparently and autonomously integrated across sustainable Industry 4.0: embedded computers and networks supervise the physical processes by use of sensors and actuators, typically with feedback loops related to computations. Physical objects can be designed with connections to the virtual world, while integrating smart mechanisms to harness real-time cooperation. Interactions taking place throughout the physical world may alter the processing operations across the virtual world, resulting in a causal connection deployable for the incessant enhancement of artificial intelligence-based decision-making algorithms. Cognizant, autonomous, and self-configuring omnipresent systems can be instrumental in deep learning-assisted smart process planning.

The advancement of sustainable groundbreaking technologies [10–20] is decisive in the present framework of inconstant market demands. The technological and operations management features of cyber-physical systems constitute the components of data-driven sustainable smart manufacturing. Smart technologies may ensure that data-driven manufacturing systems are sustainable. Blockchain constitutes a breakthrough advancement of information technology for carrying out big data-driven innovation in sustainable Industry 4.0. The transparency features facilitated by blockchain may improve the sustainability of cyber-physical system-based smart factories and manufacturing networks. Blockchain-empowered sustainable manufacturing articulates product lifecycle management effectively. Sustainable smart manufacturing represents a value-added recovery operation that can restore the value of the deteriorated product to its initial specific value. Remanufacturing represents a lifecycle renewal operation aiming to achieve green sustainable manufacturing. Industry 4.0-based manufacturing systems, sustainable product lifecycle management, real-time process monitoring, Internet of Things sensing networks, and industrial big data, through cognitive decision-making algorithms, can be harnessed to carry out the indeterminate quality of deteriorated products by generating, supervising, and inspecting continuous real-time data throughout the elaborate remanufacturing process. Implementation of Internet of Things sensing networks, real-time big data analytics, cyber-physical production systems, and artificial intelligence-based decision-making algorithms improve logistics processes, resulting in the sustainability of the retail industry. Deployment of Internet of Things-based manufacturing systems can assimilate supply chain operations, thus enhancing the sustainability of retail companies. By use of data sharing, visibility, and auto-capture, Internet of Things-based real-time production logistics enhances the supply chain performance dynamics as regards expenses, quality, delivery, and adjustability, consequently shaping the environmental, economic, and social sustainability of retail companies. Product sustainability is related to cyber-physical smart manufacturing systems. Product design capabilities constitute a pivotal source and an essential determinant for data-driven sustainable smart manufacturing competition. Product sustainable design takes into account environmental, economic, and social sustainability throughout the lifecycle of manufactured goods, thus generating products having significant low-carbon features.

Cyber-physical systems further sustainable smart manufacturing at full length of the lifecycle [21–27], enhancing the logistics, design, performance, and maintenance of digitized mass production systems. Internet of Things-based manufacturing systems

can carry out the distribution and assimilation of data and production across various lifecycle stages, thus enabling sustainable product lifecycle management. Internet of Things smart devices can gather and inspect instantaneous data and together with real-time big data analytics and industrial artificial intelligence can configure end-user behavior and grasp the relevance for stakeholders, while articulating sustainable industrial value creation and displaying coherently the significant market segment and required features as regards reliability, precision, and extensiveness. Market analyses can shape the value chain to thoroughly identify the demands and determine latent criteria. Smart technological enhancements assist in optimizing prediction as regards maintenance, straightening out the service schedules, and the networking between product processes and low-carbon performance. The major outcomes can be assessed based on real-time big data analytics and industrial artificial intelligence in conjunction with standard appraisal procedures, and subsequent insights can lead to unbiased and rigorous decisions. By use of Internet of Things-based manufacturing systems, industrial big data and knowledge distributed throughout diverse lifecycle management branches can be decisively enabled, while more coherent and accurate decision-making concerning sustainable lifecycle management can be attained. Digital twin, pivotal in advancing sustainable smart manufacturing, designates a virtual image of a physical system in every part of its lifecycle. The implementation of digital twin technology is associated with Internet of Things-based manufacturing systems, covering product design, operational maintenance, and output planning processes, while catalyzing advancements across product lifecycle management.

As advancement to the manufacturing sector, Industry 4.0 wireless networks assist smart production systems [28–33] in attaining significant flexibility, swift design alterations, digital data technology, and adjustable technical workforce practice. The digital twin can sense the state of sustainable smart manufacturing systems instantaneously and forecast system failures. Digital twin-driven sustainable smart manufacturing comprises a basic platform, equipment, system, and service. Sustainable smart manufacturing platforms can be networked to assimilate the value chain throughout businesses and constitute a groundbreaking industrial form assisted by cognitive decision-making algorithms. The industrial big data of the basic platform is derived from its equipment layer comprising unit, production line, and manufacturing plant, in association with cloud computing and artificial intelligence data-driven Internet of Things systems. By thoroughly taking into account environmental, economic, and social aspects, and integrating personnel, machines, and cyber-physical production systems, industrial big data supply input for virtual and physical prototyping that shapes sustainable smart manufacturing equipment, systems, and services. Sustainable smart manufacturing equipment comprises a production unit and line; that is, machine tools, advanced robots, customized equipment, and assessment and monitoring technologies. The sustainable smart manufacturing system encompasses a discrete and a process component. Horizontally, the sustainable smart manufacturing system can be segmented into design, production, logistics, sales, and services, constituting a closed loop. Vertically, the sustainable smart manufacturing system can be segmented into automatic production and execution systems, and organizational resource management.

Data-driven sustainable smart manufacturing, Internet of Things-based real-time production logistics, and product decision-making information systems [28,34–39] facilitate the networking between the production equipment and manufactured goods. Sustainable smart manufacturing service consists of product advancement, operational manufacturing, and after-sales services. Product advancement services integrate shared design and product customization, manufacturing services assimilate sensor-based monitoring and collaborative manufacturing, while after-sales services subsume fault diagnosis and operational maintenance. Smart manufacturing equipment harmonizes sensing analysis, cognitive decision-making, and supervision functions developed on artificial intelligence-based decision-making algorithms. The smart manufacturing service chiefly covers the entire operation of product processing and manufacturing, while supplying monitoring, scheduling, and real-time warning. With the adoption of digital twin-based big data-driven

sustainable smart production, manufacturing accuracy, product quality, and processing performance would incessantly optimize the operations. The digital twin and industrial big data technologies can configure virtual simulation models, being harnessed to digital real-time product analysis and machine fault diagnosis and reconditioning. The production equipment can autonomously sense the processing quality of the manufactured goods and make prompt changes. Smart manufacturing and digital twin deploy sensing and simulation, while controlling the status of manufactured goods and production equipment instantaneously and forecasting possible subsequent failures.

4. Big Data-Driven Smart Sustainable Energy and Electric Systems

The configuration of a significant business value in cyber-physical production systems [40–46] necessitates enhanced internal logistics systems as regards operational performance, operating time, and sustainability by use of Internet of Things-driven analytics. Key performance indicators may address operational assessments concerning expenses, time, quality, adjustability, and sustainability, and can be significant to manufacturing, inventory administration, quality assurance, and maintenance. Intralogistics is instrumental in productive capacity, operational performance, equipment effectiveness, sustainability, and energy consumption. The implementation of Internet of Things-driven analytics culminates in the upgrading of internal logistics systems as regards operational performance, operating time, and sustainability. While Internet of Things-enabled data value chains handle the collection, transfer, and coherent transformation of unprocessed information into applied knowledge, their integration within cyber-physical systems can provide their by-products in intralogistics practice. Cyber-physical production systems are pivotal in the advancement of cutting-edge big data-driven smart energy systems. Groundbreaking computational methodologies (e.g., environmentally friendly and energy efficient cyber-physical production system design) facilitate the sustainable development of deep learning-assisted smart process planning. Cyber-physical production systems can be harnessed to engage in the decrease of energy generated from extensive information center computing infrastructures and in the enhancement of computational coherence measurements across smart energy systems.

The circular economy is a factor in energy-intensive sectors [47–55], participating in ethical sustainable societal development. In Industry 4.0, big data-driven technologies assist in the adoption of a cleaner production approach and in the advancement of data-driven sustainable smart manufacturing. Companies are under significant pressure towards ethical, efficient, and sustainable manufacturing operations in relation to Industry 4.0 and circular economy. For sustainable performance, products have to be manufactured through low-carbon, socially feasible, and economically robust digital operations. Cyber-physical production systems developed on ethical and sustainable manufacturing operations are coherent in reducing the use of energy and natural resources. Companies should integrate Internet of Things-based real-time production logistics, deep learning-assisted smart process planning, and industrial big data analytics with various cyber-physical production systems to perform ethical and sustainable value addition activities that lead to resource optimization while altering market demands. Smart sustainable energy and electric systems are heterogeneous, highly elaborate, and nonlinear. The assimilation of discontinuous renewable energy sources together with particular household consumption behaviors generates unpredictability throughout smart sustainable energy and electric systems. The performance, supervision, and decision-making in an unstable environment necessitate growing automation and adjustability in operational monitoring, and an increase in efficiency to ensure the required level of service provided by smart sustainable energy and electric systems. Reinforcement learning constitutes a broad category of optimal control approaches that harnesses projected value functions by use of machine learning and simulation in an extremely dynamic stochastic setting. The interactive environment facilitates the advancement of robust learning ability and significant flexibility in reinforcement learning that does not employ the model of system dynamics, making it applicable

for smart sustainable energy and electric systems having elaborate nonlinearity and unpredictability. Leveraging reinforcement learning across smart sustainable energy and electric systems alters the standard energy utilization mode by using cognitive automation, artificial intelligence-based decision-making algorithms, and real-time sensor networks.

Smart manufacturing is instrumental in advancing more sustainable and effective products [56–63]: energy use and quality of manufactured products are satisfactorily supervised, leading to smart sustainable manufacturing, cleaner production, and emission decrease. The sustainability and effectiveness of the smart manufacturing systems are improved by supplying trustworthy input. Data mining is employed on a large scale in manufacturing and service sectors, enabling decisions on acquirable data, and in sustainable manufacturing settings. Additive manufacturing can save energy and lead to cleaner environmental production as a result of the decrease in material and resource use. With the advancements in big data technologies, huge volumes of data are produced during additive manufacturing operations. The upsides of 5G technology are superior reliability and reduced latency, enhancing the real-time performance and monitoring, in addition to decision-making capabilities of sustainable and smart additive manufacturing processes. Product decision-making information systems, technologies, and applications generate huge volumes of data during additive manufacturing product designing, fabrication operations, and product maintenance, articulating the entire manufacturing cycle architecture. As wide-ranging scalability necessitates breakthroughs in operational management practices and energy efficiency systems, blockchain can optimize performance deficiencies, irregular or inadequate services, funding schemes, and controlling networks. Distributed ledger-based technologies may play a part in the management and adoption of sustainable development proposals. Efficiency benefits in public administration operations associated with the feasible leverage of energy from sustainable sources underline the relevance of distributed-ledger technologies whose harnessing is a means to consider and require enhancements in key domains for the adoption of major sustainability initiatives. Distributed-ledger technology is determining in large-scale cross-border undertakings and for heterogeneous stakeholders to influence the digital ecosystem consistent with sustainable development routes.

Advancing economic, data-driven, and resource-efficient farming arrangements to satisfy large-scale nutrient demand is related to the growing population and incessant urbanization [64–72] that make food security relevant across sustainable development. Renewable energy and biodegradable/organic waste use may configure sustainable food production systems by use of deep learning-assisted smart process planning, artificial intelligence data-driven Internet of Things systems, and cognitive decision-making algorithms, thus enabling the consolidation of circular economy. The energy and material consumption associated with vegetable production operations and the environmental and economic performance throughout sustainable farming systems can be carried out effectively by use of cyber-physical manufacturing systems powered by artificial intelligence-based decision-making algorithms specific to Industry 4.0 wireless networks. Decarbonization technologies of sustainable energy provision are critical to controlling pervasive greenhouse gas emissions and consequently thoroughly mitigating climate change. Industrial big data analytics, deep learning-assisted smart process planning, sustainable product lifecycle management, and cognitive decision-making algorithms can assist throughout the decarbonization process by use of digital technologies while necessitating minimal investments. Cyber-physical production systems can strengthen efficiency of sustainable energy provision and big data-driven industrial production, definitely straightening out economic viability and low-carbon effects. Digitalization of sustainable energy systems by harnessing cyber-physical production systems redesigns the marginal abatement cost curve and refashions the shift towards an environmentally friendly energy system. When cyber-physical production systems are integrated into artificial intelligence data-driven Internet of Things systems, decarbonization technologies may advance considerably while generating unpredictable risks.

A sustainable smart energy system associated with artificial intelligence-based decision-making algorithms, business process optimization, and Internet of Things sensing networks [73–82] would surpass standard energy systems that confront pressing environmental and social concerns, while renewable energy systems have diminished reliability as a result of the discontinuous character of energy sources. Peer-to-peer energy communities network electricity end-users and producers on digital platforms enabling them to trade energy cooperatively. By integrating local production and use, connecting reorganized participants, and configuring new markets, peer-to-peer energy communities can further a more sustainable energy system. Sustainable business models may provide system transition value, resulting in the expansion of Internet of Things-based real-time production logistics, refashioning of the energy markets, and asking customers to support a sustainable smart energy system. Due to fluid and unmanageable market alterations, manufacturers have to reorganize their production process so as to satisfy fluctuating consumer demands variably and produce first-rate quality goods competitively while remaining sustainable by cutting down carbon emission and energy use. Behavioral intentions by themselves do not result in pro-environmental consumption, green consumption options entail unrelated aspects in preference over behavioral intentions, and companies' environmental operations turn consumer's environmentally friendly intentions into ecologically sound behavior. Companies' sustainability exposure and low-carbon responsiveness perform the function of driver for energy-efficient consumption practices, constituting the threshold for altering the ulterior motive and consumer's environmental choices. Energy-efficient awareness considerably moderates the operational connection between ecologically sound disclosure and consumer's compliance to participate in environmentally responsible consumption activities. Companies' sustainability exposure in furthering ecologically sound consumption practices should take into account the environmental deterioration generated by human activities.

Advancing towards sustainable energy outcomes in the urban big data-driven environment by coherently assimilating renewable energy systems [83–90] reinforces decarbonization across the clean energy industry and climate change mitigation. Optimizing energy production and storage by use of sustainable strategies to meet subsequent demands and taking measures as regards the climate targets necessitate a significant alteration throughout the energy infrastructure. Climate change mitigation and remodeling approaches demand a predictable impact evaluation of climate change with regard to energy systems and adequate assessment of sustainable energy solutions. Enhancing the energy systems to resist successfully climate dissimilarities in a sound way is critical in carrying out the sustainable energy transition. Improving the network between climate and energy system patterns and furthering the configuration of energy technologies to grapple with subsequent climate variations in an adjustable fashion is instrumental in articulating the sustainable shift of operational systems to renewable energy. To straighten out their efficiency and sustainability, urban energy systems require transition. A sustainable shift of the energy industry is partly responsible for mitigating climate change, but an effective transition needs suitable climate change adaptation while considering climate uncertainties and extremes. Public-sector regions and their energy systems can bring to completion a successful operational shift and climate change adaptation. A robust design can advance the energy system in the direction of superior flexibility and resilience, suppressing irremediable environmental conditions and significant economic downsides.

5. Sustainable Circular Economy Issues in Precision Agriculture and Smart Farming Production Systems

Circular economy assists organizations in carrying out business outcomes [91–97] by adopting sustainable operations. Business models associated with big data-driven technologies can orient companies toward improving supply chain sustainability outcomes by use of circular economy criteria. Industry 4.0 wireless networks stimulate businesses to set up a consonance between the economic feasibility of their decisions and low-carbon effects, but they necessitate coherent knowledge representation patterns concerning sustainable

industrial value creation. Industry 4.0 enables data gathering by use of sensor technologies, so that software tools can inspect data instantaneously through decision support systems that analyze the data flows and further decision-making throughout various levels of investigation. Industry 4.0 boosts the proportion of input distribution across the supply chain, optimizes the product lifecycle straightforwardly, accelerates the accumulation of novel data types, and improves expedient decision-making regarding Internet of Things-enabled sustainability. Inadequate capabilities of standard decision-making approaches demarcate the capacities of companies to thoroughly deploy big data technologies. Cutting-edge software tools and techniques have to be assimilated across smart factories and cyber-physical production systems to facilitate actual assessment of the environmental consequences of manufacturing operations from unrestricted sources. Sensors can assist in gathering suitable data, while protocol advancement for data integration is associated with assimilation of sustainability criteria across smart factories. Industry 4.0 enables adoption of circular economy by leveraging resources, upgrading operations, employment of assets, labor output, handling of records, quality enhancement, cutting down time to market, compatibility between supply and demand, and coherent provision of service and aftersales. Data gathering and inspection capabilities facilitated by Industry 4.0 are decisive in managing sustainability issues, while data sharing assists companies in assimilating sustainability criteria into their business models. An unambiguous and traceable product lifecycle may reduce waste generation and curtail emissions throughout sustainable circular economy. In Industry 4.0 wireless networks, tracking technologies assist companies in supervising manufactured products during their lifecycle and accumulate datasets that necessitate the advancement of precise distribution procedures for clarifying corresponding allocations of environmental burdens across various products and sectors.

Cutting-edge processing technologies and groundbreaking food systems call in question the current operational chains [98–104] by advancing more sustainably nutritious food options. Advanced food systems develop on inferior technology readiness levels and assessment of their possible subsequent benefits or obstacles constitutes an intricate task as a result of lacking integrated data. The cyber-physical character of modern food is decisive for the engineering of sustainably nutritious food systems. Adoption of machine learning approaches for the gathering, assimilation, and inspection of data related to biomass production and handling on heterogeneous levels results in the accurate investigation of food systems and appraisal of developing advantages, in addition to likely adverse rebound consequences in relation to societal attitude. Data-integrated evaluation systems enable straightforwardness of chains, incorporation of nutritional and environmental features, and configuration of customized nutrition technologies. Food production-consumption chains are promising cyber-physical systems, appropriate for computerized traceability, sustainability determination, and personalized nutrition. Data-driven smart sustainable manufacturing, product decision-making information systems, and digital automated production assists precision farming in organizing various application capabilities related to agricultural processes, e.g., data gathering, sensing-on-the-move techniques, cloud computing, cyber-physical production systems management, Internet of Things sensing and actuation, and autonomous vehicle decision-making algorithms. The networking of agricultural deep learning-assisted smart process planning cyber-physical systems instantaneously optimize efficiency, operational output, animal health, and food quality, while decreasing farm labor expenses. Industry 4.0 wireless networks assisted by artificial intelligence-based decision-making algorithms and big data analytics can positively impact sustainable smart production systems and circular economy capabilities by reducing environmental pollution.

Big data-driven decision-making processes, digitized mass production, industrial big data analytics, and Internet of Things sensing networks [105–112] can serve as groundbreaking tools in dealing with sustainability issues in precision agriculture and smart farming production systems, thereby ensuring food security and safety, together with ecological sustainability. Product decision-making information systems, deep learning-assisted

smart process planning, big data-driven innovation, cloud computing, and sustainable blockchain technologies can be decisive in optimizing environmental stewardship, productivity and yield enhancement, fostering soil and plant health, and water conservation. Machine learning techniques and algorithms can supply real-time analytic clarifications for action-oriented data-driven decision-making algorithms throughout agricultural supply chains, improving their productivity and sustainability. Aiming to attain sustainability in business operations, companies are likely to adopt green practices. Sustainable business practices and operational performance are adequately connected and significantly impact organizational sustainability. Industry 4.0-based manufacturing systems give attention to the suitable compatibility between smart-centric resource performance and data-driven sustainable organizational capabilities. With robust stakeholder involvement in organizational structure and functions, companies can harness their resources to attain first-rate operational proficiency by use of Internet of Things-based real-time production logistics while advancing sustainable performance. Organizational dynamic capability is instrumental in configuring a state of coherent sustainability in operational performance developed on deep learning-assisted smart process planning. Companies should judiciously articulate smart-centric resource performance by advancing dynamic capability for data-driven sustainable operations.

Big data configure elaborate cyber-physical production systems instrumental in the economic and green operations of farming [113–119], serving as a speciation mechanism, bringing about intense competition, and impacting agricultural sustainability, while representing a self-renewable resource for it. Sustainable and smart products constitute cutting-edge manufactured goods typified by servitization and environmental concerns. The growing intricacy of sustainable and smart products makes it difficult for companies to perform data-driven sustainable breakthroughs. Sustainable and smart product innovation furthers the operational stream, integration, and distribution of groundbreaking resources and data by use of cyber-physical production systems, deep learning-assisted smart process planning, cognitive decision-making algorithms, and Internet of Things sensing networks. Sustainable and smart product innovation is a business model synthesis of sustainable product and service. Sustainable industrial value creation, data-driven sustainable smart manufacturing, automated production systems, and artificial intelligence-based decision-making algorithms are instrumental in assimilating sustainability into innovative business models. Sustainable value flows give rise to synergic innovation performance and the coherent and thorough attainment of ecosystem sustainability objectives. Environmentally friendly manufactured goods and services articulate the sustainable and smart product ecosystem developed on Industry 4.0 wireless networks, Internet of Things-based real-time production logistics, deep learning-assisted smart process planning, and cyber-physical manufacturing networks. Sustainable industrial value creation is instrumental in configuring the sustainable and smart product innovation ecosystem through real-time process monitoring, cognitive decision-making algorithms, and artificial intelligence data-driven Internet of Things systems.

6. Discussion

Cyber-physical production systems bring about operations shaping social sustainability performance technologically. The digital twin can sense the state of sustainable smart manufacturing systems instantaneously and forecast system failures. Social sustainability, cyber-physical production systems, and performance assessment articulate cutting-edge manufacturing processes. Sustainable smart manufacturing platforms can be networked to assimilate the value chain throughout businesses and constitute a groundbreaking industrial form assisted by cognitive decision-making algorithms. Cognizant, autonomous, and self-configuring omnipresent systems can be instrumental in deep learning-assisted smart process planning. With the adoption of digital twin-based big data-driven sustainable smart production, manufacturing accuracy, product quality, and processing performance would incessantly optimize. The technological and operations management features of

cyber-physical systems constitute the components of data-driven sustainable smart manufacturing. Internet of Things-enabled data value chains handle the collection, transfer, and coherent transformation of unprocessed information into applied knowledge. The transparency features facilitated by blockchain may improve the sustainability of cyber-physical system-based smart factories and manufacturing networks. Cyber-physical production systems are pivotal in the advancement of cutting-edge big data-driven smart energy systems.

Implementation of Internet of Things sensing networks, real-time big data analytics, cyber-physical production systems, and artificial intelligence-based decision-making algorithms improve logistics processes, resulting in the sustainability of the retail industry. In Industry 4.0, big data-driven technologies assist in the adoption of a cleaner production approach and the advancement of sustainable smart manufacturing. Deployment of Internet of Things-based manufacturing systems can assimilate supply chain operations, thus enhancing the sustainability of retail companies. Renewable energy and biodegradable/organic waste use may configure sustainable food production systems by use of deep learning-assisted smart process planning, artificial intelligence data-driven Internet of Things systems, and cognitive decision-making algorithms. Product sustainable design takes into account environmental, economic, and social sustainability throughout the lifecycle of manufactured goods, thus generating products having significant low-carbon features. Industrial big data analytics, deep learning-assisted smart process planning, sustainable product lifecycle management, and cognitive decision-making algorithms can assist throughout the decarbonization process by use of digital technologies.

Internet of Things smart devices can gather and inspect instantaneous data and together with real-time big data analytics and industrial artificial intelligence can configure end-user behavior and grasp the relevance for stakeholders. Cyber-physical production systems can strengthen efficiency of sustainable energy provision and big data-driven industrial production. By use of Internet of Things-based manufacturing systems, industrial big data and knowledge distributed throughout diverse lifecycle management branches can be decisively enabled. Industry 4.0 wireless networks stimulate businesses to set up a consonance between the economic feasibility of their decisions and low-carbon effects. The implementation of digital twin technology is associated with Internet of Things-based manufacturing systems, covering product design, operational maintenance, and output planning processes, while catalyzing advancements across product lifecycle management.

7. Conclusions

Significant research has lately analyzed whether industrial big data analytics, deep learning-assisted smart process planning, sustainable product lifecycle management, and cognitive decision-making algorithms can assist throughout the decarbonization process by use of digital technologies. By harnessing Internet of Things-based manufacturing systems, industrial big data and knowledge distributed throughout diverse lifecycle management branches can be decisively enabled. Industry 4.0 wireless networks stimulate businesses to set up a consonance between the economic feasibility of their decisions and low-carbon effects. Practical approaches to sustainable cyber-physical production systems across big data-driven smart urban economy can be configured through adopting cognitive automation, advanced robotics, and deep learning-assisted smart process planning developed on artificial intelligence-based decision-making algorithms. Real-time sensor networks, industrial big data analytics, and Internet of Things-based real-time production logistics are instrumental in articulating digitized mass production in sustainable Industry 4.0. Internet of Things sensing networks, real-time process monitoring, and cognitive decision-making algorithms assist in business process optimization by use of smart connected sensors, with the aim of bringing about smart industrial value creation throughout sustainable product lifecycle management.

The conclusions drawn from the above analyses indicate that sustainable smart manufacturing platforms can be networked to assimilate the value chain throughout businesses and constitute a groundbreaking industrial form assisted by cognitive decision-making

algorithms. Implementation of Internet of Things sensing networks, real-time big data analytics, cyber-physical production systems, and artificial intelligence-based decision-making algorithms improve logistics processes.

As to the limitations in this research, by analyzing only articles published in journals indexed in ProQuest, Scopus, and Web of Science databases in 2019 and 2020, we may have disregarded other relevant sources on sustainable cyber-physical production systems in big data-driven smart urban economy. Future research should investigate whether Industry 4.0-based manufacturing technologies can ensure the sustainability of big data-driven production systems by use of Internet of Things sensing networks and deep learning-assisted smart process planning.

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