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Blockchain and Sustainability: A Tertiary Study

#	Authors	Title	Year	Abstract	Decision	Topic/Domain	supply chain?
1	Jović M., Tijan E., Žgaljić D., Aksentijević S.	Improving maritime transport sustainability using blockchain-based information exchange	2020	In this paper, the authors perform a comprehensive literature review of the positive impacts of blockchain-based information exchange in the maritime transport sector, as well as the challenges and barriers for successful blockchain-based information exchange, considering all three aspects of the sustainability (economic, environmental, and social). The papers from relevant databases (Web of Science and Scopus) and selected studies have been used. The literature coverage was expanded by using backward snowball sampling. In total, 20 positive impacts and 20 challenges/barriers were singled out. Despite the identified barriers and challenges (such as the slow acceptance of blockchain technology in the maritime transport sector or the high implementation cost), blockchain technology possesses a definite potential to improve the information exchange between all involved stakeholders (for example, by improving the visibility across transport routes and by reducing the paper-based processes), positively affecting all three aspects of sustainability. The authors contribute to the existing research of the economic aspect of maritime transport sustainability by blockchain-based information exchange by expanding it and by researching the environmental and social aspects of sustainability. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Include	maritime transport (supply chain included)	x
2	Choo K.-K.R., Ozcan S., Dehghantanha A., Parizi R.M.	Editorial: Blockchain Ecosystem - Technological and Management Opportunities and Challenges	2020	Blockchain is increasingly deployed in a broad range of sectors, ranging from banking and finance to manufacturing to energy to transportation, and so on. While many technological and business related blockchain developments and challenges have been identified, many of these engineering and management challenges have not been addressed. The ongoing interest in this topic is also partly evidenced by the large number of submissions we received in this special issue. Of the 200 submissions, only 39 articles were eventually accepted after several rounds of rigorous reviews (i.e., acceptance rate of 19.5%). In this editorial, we report on the findings from the first 36 articles on a broad range of topics (e.g., supply chain, financial technology, Internet of Things, smart city, healthcare, security, privacy, and blockchain building blocks such as consensus algorithms). Hopefully, the findings reported in these 36 accepted articles will provide sustainable solutions for existing and future blockchain systems and platforms. © 1988-2012 IEEE.	Exclude	N/A	
3	Elmamy S.B., Mrabet H., Gharbi H., Jemai A., Trentesaux D.	A survey on the usage of blockchain technology for cyber-threats in the context of industry 4.0	2020	A systematic review of the literature is presented related to the usage of blockchain technology (BCT) for cyber-threats in the context of Industry 4.0. BCT plays a crucial role in creating smart factories and it is recognized as a core technology that triggers a disruptive revolution in Industry 4.0. Beyond security, authentication, asset tracking and the exchange of smart contracts, BCTs allow terminals to exchange information according to mutually agreed rules within a secured manner. Consequently, BCT can play a crucial role in industrial sustainability by preserving the assets and the environment and by enhancing the quality of life of citizens. In this work, a classification of the most important cyber-attacks that occurred in the last decade in Industry 4.0 is proposed based on four classes. The latter classes cover scanning, local to remote, power of root and denial of service (DoS). BCT is also defined and various types belong to BCT are introduced and highlighted. Likewise, BCT protocols and implementations are discussed as well. BCT implementation includes linear structure and directed acyclic graph (DAG) technology. Then, a comparative study of the most relevant works based on BCT in Industry 4.0 is conducted in terms of confidentiality, integrity, availability, privacy and multifactor authentication features. Our review shows that the integration of BCT in industry can ensure data confidentiality and integrity and should be enforced to preserve data availability and privacy. Future research directions towards enforcing BCT in the industrial field by considering machine learning, 5G/6G mobile systems and new emergent technologies are presented. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Include	industry 4.0, smart manufacturing	
4	Demestichas K., Daskalakis E.	Data lifecycle management in precision agriculture supported by information and communication technology	2020	The role of agriculture in environmental degradation and climate change has been at the center of a long-lasting and controversial debate. This situation combined with the expected growth in crop demand and the increasing prices of fertilizers and pesticides has made the need for a more resource-efficient and environmentally sustainable agriculture more evident than ever. Precision agriculture (PA), as a relatively new farming management concept, aims to improve crop performance as well as to reduce the environmental footprint by utilizing information about the temporal and the spatial variability of crops. Information and communication technology (ICT) systems have influenced and shaped every part of modern life, and PA is no exception. The current paper conducts a literature review of prominent ICT solutions, focusing on their role in supporting different phases of the lifecycle of PA-related data. In addition to this, a data lifecycle model was developed as part of a novel categorization approach for the analyzed solutions. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Exclude	agriculture	

5	Leng J., Ruan G., Jiang P., Xu K., Liu Q., Zhou X., Liu C.	Blockchain-empowered sustainable manufacturing and product lifecycle management in industry 4.0: A survey	2020	Sustainability is a pressing need, as well as an engineering challenge, in the modern world. Developing smart technologies is a critical way to ensure that future manufacturing systems are sustainable. Blockchain is a next-generation development of information technology for realizing sustainability in businesses and industries. Much research on blockchain-empowered sustainable manufacturing in Industry 4.0 has been conducted from technical, commercial, organizational, and operational perspectives. This paper surveys how blockchain can overcome potential barriers to achieving sustainability from two perspectives, namely, the manufacturing system perspective and the product lifecycle management perspective. The survey first examines literature on these two perspectives, following which the state of research in blockchain-empowered sustainable manufacturing is presented, which sheds new light on urgent issues as part of the UN's Sustainable Development Goals. We found that blockchain-empowered transformation of a sustainable manufacturing paradigm is still in an early stage of the hype phase, proceeding toward full adoption. The survey ends with a discussion of challenges regarding techniques, social barriers, standards, and regulations with respect to blockchain-empowered manufacturing applications. The paper concludes with a discussion of challenges and social barriers that blockchain technology must overcome to demonstrate its sustainability in industrial and business spheres. © 2020 Elsevier Ltd	Include	Sustainable manufacturing, industry 4.0; supply chain is included, although not main focus	x
6	Demestichas K., Daskalakis E.	Information and communication technology solutions for the circular economy	2020	The concept of circular economy (CE) is becoming progressively popular with academia, industry, and policymakers, as a potential path towards a more sustainable economic system. Information and communication technology (ICT) systems have influenced every aspect of modern life and the CE is no exception. Cutting-edge technologies, such as big data, cloud computing, cyber-physical systems, internet of things, virtual and augmented reality, and blockchain, can play an integral role in the embracing of CE concepts and the rollout of CE programs by governments, organizations, and society as a whole. The current paper conducts an extensive academic literature review on prominent ICT solutions paving the way towards a CE. For the categorization of the solutions, a novel two-fold approach is introduced, focusing on both the technological aspect of the solutions (e.g., communications, computing, data analysis, etc.), and the main CE concept(s) employed (i.e., reduce, reuse, recycle and restore) that each solution is the most relevant to. The role of each solution in the transition to CE is highlighted. Results suggest that ICT solutions related to data collection and data analysis, and in particular to the internet of things, blockchain, digital platforms, artificial intelligence algorithms, and software tools, are amongst the most popular solutions proposed by academic researchers. Results also suggest that greater emphasis is placed on the "reduce" component of the CE, although ICT solutions for the other "R" components, as well as holistic ICT-based solutions, do exist as well. Specific important challenges impeding the adoption of ICT solutions for the CE are also identified and reviewed, with consumer and business attitude, economic costs, possible environmental impacts, lack of education around the CE, and lack of familiarization with modern technologies being found among the most prominent ones. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Exclude	Circular economy	
7	Paliwal V., Chandra S., Sharma S.	Blockchain technology for sustainable supply chain management: A systematic literature review and a classification framework	2020	Through a systematic review of publications in reputed peer-reviewed journals, this paper investigates the role of blockchain technology in sustainable supply chain management. It uses the What, Who, Where, When, How, and Why (SW+1H) pattern to formulate research objectives and questions. The review considers publications since 2015, and it includes 187 papers published in 2017, 2018, 2019, and the early part of 2020, since no significant publications were found in the year 2015 or 2016 on this subject. It proposes a reusable classification framework-emerging technology literature classification level (ETLCL) framework-based on grounded theory and the technology readiness level for conducting literature reviews in various focus areas of an emerging technology. Subsequently, the study uses ETLCL to classify the literature on our focus area. The results show traceability and transparency as the key benefits of applying blockchain technology. They also indicate a heightened interest in blockchain-based information systems for sustainable supply chain management starting since 2017. This paper offers invaluable insights for managers and leaders who envision sustainability as an essential component of their business. The findings demonstrate the disruptive power and role of blockchain-based information systems. Given the relative novelty of the topic and its scattered literature, the paper helps practitioners examining its various aspects by directing them to the right information sources. © 2020 by the authors.	Include	Sustainable supply chain management	x
8	Wang Q., Su M., Li R.	Is China the world's blockchain leader? Evidence, evolution and outlook of China's blockchain research	2020	China wants to embrace blockchain, the technology has triggered a new round of technological innovation and industrial change and has huge potential to enhance sustainable development capabilities in many areas. The purpose of this paper is to explore the global status of China's blockchain research. This study applies bibliometric analysis to perform statistical and correlation analysis on the blockchain literature from 2013 to 2019 included in the Web of Science (WOS) database and draws the social network with visual analysis technology. The statistical results show that China is the country that publishes the most blockchain papers in the world, leading the global blockchain research. Research institutions and authors from China also dominate global blockchain research. Further, this paper investigates the development process of China's blockchain research and determines the development stage through a comparative analysis with the United States. More specifically, the paper comprehensively analyzes the current status of China's blockchain research from three perspectives: the subject area, high-yield institutions and high-yield authors. The results indicate that China's blockchain research is experiencing rapid growth, and the research scope is constantly expanding, with the research focus gradually shifting to applied research. Finally, this paper summarizes the challenges faced by China's blockchain research and puts forward corresponding policy recommendations for reference by policy makers. © 2020 Elsevier Ltd	Exclude	BC research, N/A	

9	Wang Q., Su M.	Integrating blockchain technology into the energy sector - From theory of blockchain to research and application of energy blockchain	2020	Blockchain technology has been ushering in nothing short of a decentralized revolution. Distributed/decentralized energy is recognized the best way to ensure energy sustainability in the future. An open question is what promise the integration of blockchain and energy hold for energy future. This paper systematically reviews the theory of blockchain and explores the current status of energy blockchain research and applications using a visual bibliometric analysis method and the Scopus database from 2014 to 2020. The results show that the number of publications about blockchain technology in the energy sector have been skyrocketing, especially since 2018, which indicates the combining blockchain technology with energy sector is a new cross-cutting research area with increasing attention. At the national level, developing countries begin to move to the world stage, catching up or even surpassing several traditional developed countries in the field of energy blockchain. Cluster analysis results show that the existing energy blockchain research focuses on renewable energy, trying to solve the bottlenecks in its development process, and providing better solutions for the replacement of fossil energy by renewable energy. We therefore contend that blockchain may be fueling the renewable energy and powering our energy sustainability. Finally, the possible future development trend of energy blockchain is offered. © 2020 Elsevier Inc.	Exclude	energy
10	Taş R., Tannöver Ö.Ö.	A systematic review of challenges and opportunities of blockchain for e-voting	2020	A blockchain is a distributed, digitized and consensus-based secure information storage mechanism. The present article provides an overview of blockchain based e-voting systems. The primary purpose of this review is to study the up-to-date state of blockchain-based voting research along with associated possible challenges while aiming to forecast future directions. The methodology applied in the review is a systematic review approach. Following an introduction to the basic structure and features of the blockchain in relation to e-voting, we provide a conceptual description of the desired blockchain-based e-voting application. Symmetrical and asymmetrical cryptography improvements play a key role in developing blockchain systems. We have extracted and reviewed 63 research papers from scientific databases that have advised the adoption of the blockchain framework to voting systems. These articles indicate that blockchain-supported voting systems may provide different solutions than traditional e-voting. We classified the main prevailing issues into the five following categories: general, integrity, coin-based, privacy and consensus. As a result of this research, it was determined that blockchain systems can provide solutions to certain problems that prevail in current election systems. On the other hand, privacy protection and transaction speed are most frequently emphasized problems in blockchain applications. Security of remote participation and scalability should be improved for sustainable blockchain based e-voting. It was concluded that frameworks needed enhancements in order to be used in voting systems due to these reservations. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Exclude	e-voting
11	Feng H., Wang X., Duan Y., Zhang J., Zhang X.	Applying blockchain technology to improve agri-food traceability: A review of development methods, benefits and challenges	2020	Traceability plays a vital role in food quality and safety management. Traditional Internet of Things (IoT) traceability systems provide the feasible solutions for the quality monitoring and traceability of food supply chains. However, most of the IoT solutions rely on the centralized server-client paradigm that makes it difficult for consumers to acquire all transaction information and to track the origins of products. Blockchain is a cutting-edge technology that has great potential for improving traceability performance by providing security and full transparency. However, the benefits, challenges and development methods of blockchain-based food traceability systems are not yet fully explored in the current literature. Therefore, the main aim of this paper is to review the blockchain technology characteristics and functionalities, identify blockchain-based solutions for addressing food traceability concerns, highlight the benefits and challenges of blockchain-based traceability systems implementation, and help researchers and practitioners to apply blockchain technology based food traceability systems by proposing an architecture design framework and suitability application analysis flowchart of blockchain based food traceability systems. The results of this study contribute to better understanding and knowledge on how to improve the food traceability by developing and implementing blockchain-based traceability systems. The paper provides valuable information for researchers and practitioners on the use of blockchain-based food traceability management and has a positive effect on the improvement of food sustainability. © 2020 Elsevier Ltd	Include	agri-food traceability, (food) supply chain
12	Edwards M., Mashatan A., Ghose S.	A review of quantum and hybrid quantum/classical blockchain protocols	2020	Blockchain technology is facing critical issues of scalability, efficiency and sustainability. These problems are necessary to solve if blockchain is to become a technology that can be used responsibly. Useful quantum computers could potentially be developed by the time that blockchain will be widely implemented for mission-critical work at financial and other institutions. Quantum computing will not only cause challenges for blockchain, but can also be harnessed to better implement parts of blockchain technologies including cryptocurrencies. We review the work that has been done in the area of quantum blockchain and hybrid quantum-classical blockchain technology and discuss open questions that remain. © 2020, Springer Science+Business Media, LLC, part of Springer Nature.	Exclude	N/A
13	Karame G., Huth M., Vishik C.	An overview of blockchain science and engineering: Blockchain science & engineering	2020	This is the preface to a special issue in the journal Royal Society Open Science, themed around blockchain technology. Since this is still an emergent and interdisciplinary field, we first provide a gentle introduction into that larger topic. Then, we discuss why this technology has been criticized for not being energy-efficient. Next, we provide an analysis of recent developments in blockchain research that may help with making blockchain technology truly sustainable. Finally, we highlight some of the contributions made by papers in this special issue. © 2020 The Authors.	Exclude	N/A

14	Omboni S., Panzeri E., Campolo L.	E-Health in Hypertension Management: an Insight into the Current and Future Role of Blood Pressure Telemonitoring	2020	Purpose of Review: Out-of-office blood pressure (BP) monitoring techniques, including home and ambulatory BP monitoring, are currently recommended by hypertension guidelines worldwide to confirm the diagnosis of hypertension and to monitor the appropriateness of treatment. However, such techniques are not always effectively implemented or timely available in the routine clinical practice. In recent years, the widespread availability of e-health solutions has stimulated the development of blood pressure telemonitoring (BPT) systems, which allow remote BP tracking and tighter and more efficient monitoring of patients' health status. Recent Findings: There is currently strong evidence that BPT may be of benefit for hypertension screening and diagnosis and for improving hypertension management. The advantage is more significant when BPT is coupled with multimodal interventions involving a physician, a nurse or pharmacist, and including education on lifestyle and risk factors and drug management. Several randomized controlled studies documented enhanced hypertension management and improved BP control of hypertensive patients through BPT. Potential additional effects of BPT are represented by improved compliance to treatment, intensification, and optimization of drug use, improved quality of life, reduction in risk of developing cardiovascular complications, and cost-saving. Applications based on m-health and making use of wearables or smartwatches integrated with machine learning models are particularly promising for the future development of efficient BPT solutions, and they will provide remarkable support decision tools for doctors. Summary: BPT and telehealth will soon disrupt hypertension management. However, which approach will be the most effective and whether it will be sustainable in the long-term still need to be elucidated. © 2020, Springer Science+Business Media, LLC, part of Springer Nature.	Exclude	N/A
15	Qian J., Ruiz-Garcia L., Fan B., Robla Villalba J.I., McCarthy U., Zhang B., Yu Q., Wu W.	Food traceability system from governmental, corporate, and consumer perspectives in the European Union and China: A comparative review	2020	Background: Food safety has garnered much worldwide attention recently for reasons that are, unfortunately, not always positive. Traceability system (TS) is designed to assure safe and good quality food, while reducing the costs of food recalls. It should encompass all stakeholders, including governments, companies, and consumers, each of whom has an important role in the implementation and guardianship of such systems. The EU and China are amongst the main players implementing TS and are constantly exploring new opportunities and monitoring challenges for TS in a time of shifting consumer demands and rapid new technology innovation. Scope and approach: This article states development stages from TS 1.0 to 3.0. and reviews TS development in a number of key countries and regions. Comparisons between the EU and China are drawn in terms of government, corporate, and consumer involvement in traceability. Key findings and conclusions: A functional TS, while providing bi-directional communication between trading partners, must meet the laws and regulations where it operates. A functional system must also consider consumer value and perception, which varies with geography. There are a variety of promising technologies available on the market today to modernize TS, including artificial intelligence (AI) and blockchain. A key finding of this research is that both the EU and China have developed significant trade links in recent years which will certainly positively impact both economies. Key to underpinning the sustainability of these trade links will be the adoption of common TS to prevent negative associations. © 2020 Elsevier Ltd	Include	Food traceability x (food supply chain included as important part, but not directly focused on)
16	Duan J., Zhang C., Gong Y., Brown S., Li Z.	A content-analysis based literature review in blockchain adoption within food supply chain	2020	According to the World Health Organization (WHO), one out of 10 people get sick from eating contaminated food. Complex food production process and globalization make food supply chain more delicate. Many technologies have been investigated in recent years to address food insecurity and achieve efficiency in dealing with food recalls. One of the most promising technologies is Blockchain, which has already been used successfully in financial aspects, such as bitcoin, and it is attracting interests from food supply chain organizations. As blockchain has characteristics, such as decentralization, security, immutability, smart contract, it is therefore expected to improve sustainable food supply chain management and food traceability. This paper applies a content-analysis based literature review in blockchain adoption within food supply chain. We propose four benefits. Blockchain can help to improve food traceability, information transparency, and recall efficiency; it can also be combined with Internet of things (IoT) to achieve better efficiency. We also propose five potential challenges, including lack of deeper understanding of blockchain, technology difficulties, raw data manipulation, difficulties of getting all stakeholders on board, and the deficiency of regulations. © 2020 by the authors. Licensee MDPI, Basel, Switzerland.	Include	food supply chain x
17	França A.S.L., Amato Neto J., Gonçalves R.F., Almeida C.M.V.B.	Proposing the use of blockchain to improve the solid waste management in small municipalities	2020	The use of the "Blockchain" technological architecture is growing worldwide, given its structural characteristics aimed at security and information integrity, without the need for a central guarantor. Although Blockchain has become known for its support of crypto-coins (or crypto currencies), especially Bitcoin, its scope has become much larger, including businesses of relevant social impact. This paper presents an application of the Ethereum's Blockchain digital architecture for the solid waste management in a small municipality in the State of São Paulo, Brazil. This application comes to replace a paper-based current system. The current system uses printed cards called Green Coins, presenting vulnerabilities that should be overcome with the implementation of the new system. The blockchain-based system provides financial management for the collection of waste in the municipality aiming at better health and socio-environmental education and the financial and social inclusion of volunteer citizens, through the use of social currency. The proposed application uses social crypto-coins and security support through Ethereum's Blockchain, instead of the printed cards currently being used, including volunteer citizens, store owners and public agents. It should contribute in a relevant way to improving the quality of life in the municipality in relation to the typical aspects of sustainability: education, health, environment, social inclusion and local economy, contributing to achieve the Sustainable Development Goals (SDGs). The proposed application may eventually expand in to other municipalities, including major urban centers and private condominiums. © 2019 Elsevier Ltd	Exclude	solid waste management

18	Mahyuni L.P., Adrian R., Darma G.S., Krisnawijaya N.N.K., Dewi I.G.A.A.P., Permana G.P.L.	Mapping the potentials of blockchain in improving supply chain performance	2020	This paper aims at reviewing and systematically mapping research on blockchain potentials in improving supply chain performance. Articles were retrieved from several prominent databases, selected, reviewed, grouped into several themes and synthesized. This paper suggests that applying blockchain in the supply chain could improve its performance in terms of transparency, traceability, sustainability, trust, and cost-efficiency. As a cutting-edge technology, blockchain has not been widely implemented in supply chain industries. Research on blockchain application in the supply chain is also relatively limited. This paper contributes to the literature by offering a comprehensive map of research on blockchain potentials in improving supply chain performance. The findings of this study will also be beneficial for managers who seek for a comprehensive understanding of how blockchain technology affects their companies particularly in supply chain management. © 2020, © 2020 The Author(s). This open access article is distributed under a Creative Commons Attribution (CC-BY) 4.0 license.	Include	supply chain	x
19	Kamble S.S., Gunasekaran A., Gawankar S.A.	Achieving sustainable performance in a data-driven agriculture supply chain: A review for research and applications	2020	The lack of industrialization, inadequacy of the management, information inaccuracy, and inefficient supply chains are the significant issues in an agri-food supply chain. The proposed solutions to overcome these challenges should not only consider the way the food is produced but also take care of societal, environmental and economic concerns. There has been increasing use of emerging technologies in the agriculture supply chains. The internet of things, the blockchain, and big data technologies are potential enablers of sustainable agriculture supply chains. These technologies are driving the agricultural supply chain towards a digital supply chain environment that is data-driven. Realizing the significance of a data-driven sustainable agriculture supply chain we extracted and reviewed 84 academic journals from 2000 to 2017. The primary purpose of the review was to understand the level of analytics used (descriptive, predictive and prescriptive), sustainable agriculture supply chain objectives attained (social, environmental and economic), the supply chain processes from where the data is collected, and the supply chain resources deployed for the same. Based on the results of the review, we propose an application framework for the practitioners involved in the agri-food supply chain that identifies the supply chain visibility and supply chain resources as the main driving force for developing data analytics capability and achieving the sustainable performance. The framework will guide the practitioners to plan their investments to build a robust data-driven agri-food supply chain. Finally, we outline the future research directions and limitations of our study. © 2019 Elsevier B.V.	Include	agriculture supply chain	x
20	Astarita V., Giorè V.P., Mirabelli G., Solina V.	A Review of Blockchain-Based Systems in Transportation	2020	This paper presents a literature review about the application of blockchain-based systems in transportation. The main aim was to identify, through the implementation of a multi-step methodology: current research-trends, main gaps in the literature, and possible future challenges. First, a bibliometric analysis was carried out to obtain a broad overview of the topic of interest. Subsequently, the most influential contributions were analysed in depth, with reference to the following two areas: supply chain and logistics; road traffic management and smart cities. The most important result is that the blockchain technology is still in an early stage, but appears extremely promising, given its possible applications within multiple fields, such as food track and trace, regulatory compliance, smart vehicles' security, and supply-demand matching. Much effort is still necessary for reaching the maturation stage because several models have been theorized in recent years, but very few have been implemented within real contexts. Moreover, the link blockchain-sustainability was explored, showing that this technology could be the trigger for limiting food waste, reducing exhaust gas emissions, favouring correct urban development, and, in general, improving quality of life. © 2019 by the authors.	Include	transportation	x
21	Motlagh N.H., Mohammadrezaei M., Hunt J., Zakeri B.	Internet of things (IoT) and the energy sector	2020	Integration of renewable energy and optimization of energy use are key enablers of sustainable energy transitions and mitigating climate change. Modern technologies such the Internet of Things (IoT) offer a wide number of applications in the energy sector, i.e. in energy supply, transmission and distribution, and demand. IoT can be employed for improving energy efficiency, increasing the share of renewable energy, and reducing environmental impacts of the energy use. This paper reviews the existing literature on the application of IoT in in energy systems, in general, and in the context of smart grids particularly. Furthermore, we discuss enabling technologies of IoT, including cloud computing and different platforms for data analysis. Furthermore, we review challenges of deploying IoT in the energy sector, including privacy and security, with some solutions to these challenges such as blockchain technology. This survey provides energy policy-makers, energy economists, and managers with an overview of the role of IoT in optimization of energy systems. © 2020 by the authors.	Exclude	energy	
22	Fernandez-Vazquez S., Rosillo R., De La Fuente D., Priore P.	Blockchain in FinTech: A mapping study	2019	Blockchain is currently one of the most important topics in both the academia and industry world, mainly due to the possible effects that the continuing application of this new technology could have. The adoption of this technology by FinTech companies constitutes the next step towards the expansion of blockchain and its sustainability. The paper conducts a mapping study on the research topics, limitations, gaps and future trends of blockchain in FinTech companies. A total of 49 papers from a scientific database (Web of Science Core Collection) have been analyzed. The results show a deep focus in challenges such as security, scalability, legal and regulatory, privacy or latency, with proposed solutions still to be far from being effective. A vast majority of the research is focused into finance and banking sector, obviating other industries that could play a crucial role in the further expansion of blockchain. This study can contribute to researchers as a starting point for their investigation, as well as a source for recommendations on future investigation directions regarding blockchain in the FinTech sector. © 2019 by the authors.	Include	FinTech	

23	Astill J., Dara R.A., Campbell M., Farber J.M., Fraser E.D.G., Sharif S., Yada R.Y.	Transparency in food supply chains: A review of enabling technology solutions	2019	Background: Modern food supply chains are complex and contain numerous stakeholders, with each performing specific roles pertaining to food production. As food supply chains become more complex, the importance of food production transparency increases. Several factors contribute to the need for transparency such as an increase in the global population, detection of foodborne illness outbreaks, efficient management of risks and recalls, and satisfying consumer demand. A case in point is the necessity that food production systems become more sustainable through improvements in production efficiency and reducing the wasting of resources and food. Other examples include the need for timely identification of the source of food production, in addition to requiring a more rapid knowledge of the cause of contamination during outbreaks of foodborne illness. Scope and approach: This review sets out to describe enabling technologies, provided by the Internet of Things (IoT), which have the potential to increase food production transparency. In addition, other technologies important for managing and using food supply chain data, such as blockchain and Big Data analytics, are reviewed. The IoT is the overarching technology which allows for data collection from multiple phases within supply chains leading to data driven transparent systems of food production. Key findings and conclusions: Enabling transparency in food supply chains via implementation of technologies will require considerable effort from all stakeholders involved, resulting in many new challenges and requirements that must be addressed. These challenges and requirements range from technical issues, such as Internet connection, storage requirements, device security, and government requirements and regulations, to those concerning consumer acceptance. © 2019 Elsevier Ltd	Include	food supply chains	x
24	O'Donovan P., O'Sullivan D.T.J.	A systematic analysis of real-world energy blockchain initiatives	2019	The application of blockchain technology to the energy sector promises to derive new operating models focused on local generation and sustainable practices, which are driven by peer-to-peer collaboration and community engagement. However, real-world energy blockchains differ from typical blockchain networks insofar as they must interoperate with grid infrastructure, adhere to energy regulations, and embody engineering principles. Naturally, these additional dimensions make real-world energy blockchains highly dependent on the participation of grid operators, engineers, and energy providers. Although much theoretical and proof-of-concept research has been published on energy blockchains, this research aims to establish a lens on real-world projects and implementations that may inform the alignment of academic and industry research agendas. This research classifies 131 real-world energy blockchain initiatives to develop an understanding of how blockchains are being applied to the energy domain, what type of failure rates can be observed from recently reported initiatives, and what level of technical and theoretical details are reported for real-world deployments. The results presented from the systematic analysis highlight that real-world energy blockchains are (a) growing exponentially year-on-year, (b) producing relatively low failure/drop-off rates (~7% since 2015), and (c) demonstrating information sharing protocols that produce content with insufficient technical and theoretical depth. © 2019 by the authors.	Exclude	energy	
25	Tijan E., Aksentijević S., Ivanić K., Jardaš M.	Blockchain technology implementation in logistics	2019	This paper researches decentralized data storage represented by blockchain technology and the possibility of its development in sustainable logistics and supply chain management. Although the benefits of blockchain technology have been most widely researched in the financial sector, major challenges in logistics, such as order delay, damage to goods, errors, and multiple data entry can also be minimized by introducing blockchain technology. This paper presents a comprehensive review of the current and rising trends of blockchain technology usage in logistics and supply chain management. © 2019 by the authors.	Include	logistics and supply chain	x
26	Horner J., Ryan P.	Blockchain standards for sustainable development	2019	Sustainable development requirements are often regarded as adding a layer of cost to production of goods and delivery of services. This perception can result in the dilution of sustainable development goals. To address this concern, it is necessary to improve both the methods by which sustainable development is achieved and the validation of its long-term benefits. Identification of better and more quantifiable indicators of value and progress are clearly linked to achieving sustainable development. This article explores the way that International Standards can help government agencies and development organizations to make sense of information communication technology and the way they can be used to improve and report outcomes. Standards can help ensure that innovations and processes are interoperable, reliable and secure. Blockchain standards will improve blockchain's reputation as a useful layer of technology for tracking and auditing data, exchanges and transactions, making it an invaluable tool for achieving transparency and trust in sustainable development programs. © 2019 the Author(s). All rights reserved.	Include	standards	
27	Gunasekaran A., Yusuf Y.Y., Adeleye E.O., Papadopoulos T., Kovvuri D., Geyil D.G.	Agile manufacturing: an evolutionary review of practices	2019	Academics and practitioners have long acknowledged the importance of agile manufacturing and related supply chains in achieving firm sustainable competitiveness. However, limited, if any, research has focused on the evolution of practices within agile manufacturing supply chains and how these are related to competitive performance objectives. To address this gap, we reviewed the literature on an agile manufacturing drawing on the evolution of manufacturing agility, attributes of agile manufacturing, the drivers of agile manufacturing, and the identification of the enabling competencies deployable for agile manufacturing. Our thesis is that agile manufacturing is at the centre of achieving a sustainable competitive advantage, especially in light of current unprecedented market instability coupled with complex customer requirements. In this regard, the emphasis which agile manufacturing places on responsive adaptability would counter the destabilising influence of competitive pressures on organisations performance criteria. We have identified five enabling competencies as the agility enablers and practices of agile manufacturing, that is, transparent customisation, agile supply chains, intelligent automation, total employee empowerment and technology integration, and further explored their joint deployment to create positive multiplier effects. Future research directions were also provided with respect to the operationalisation of the five identified enablers and the potential for emergent technologies of big data, blockchain, and Internet of Things to shape future agile manufacturing practices. © 2018, © 2018 Informa UK Limited, trading as Taylor & Francis Group.	Exclude	manufacturing	

28	Tiwari P., Ilavarasan P.V., Punia S.	Content analysis of literature on big data in smart cities	2019	<p>Purpose: The purpose of this paper is to provide a systematic literature review on the technological aspects of smart cities and to give insights about current trends, sources of research, contributing authors and countries. It is required to understand technical concepts like information technology, big data analytics, Internet of Things and blockchain needed to implement smart city models successfully.</p> <p>Design/methodology/approach: The data were collected from the Scopus database, and analysis techniques like bibliometric analysis, network analysis and content analysis were used to obtain research trends, publications growth, top contributing authors and nations in the domain of smart cities. Also, these analytical techniques identified various fields within the literature on smart cities and supported to design a conceptual framework for Industry 4.0 adoption in a smart city. Findings: The bibliometric analysis shows that research publications have increased significantly over the last couple of years. It has found that developing countries like China is leading the research on smart cities. The network analytics and article classification identified six domains within the literature on smart cities. A conceptual framework for the smart city has proposed for the successful implementation of Industry 4.0 technologies. Originality/value: This paper explores the role of Industry 4.0 technologies in smart cities. The bibliometric data on publications from the year 2013 to 2018 were used and investigated by using advanced analytical techniques. The paper reviewS key technical concepts for the successful execution of a smart city model. It also gives an idea about various technical considerations required for the implementation of the smart city model through a conceptual framework. © 2019, Emerald Publishing Limited.</p>	Exclude	smart cities
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29	Mosavi A., Salimi M., Ardabili S.F., Rabczuk T., Shamsirband S., Varkonyi-Koczy A.R.	State of the art of machine learning models in energy systems, a systematic review	2019	<p>Machine learning (ML) models have been widely used in the modeling, design and prediction in energy systems. During the past two decades, there has been a dramatic increase in the advancement and application of various types of ML models for energy systems. This paper presents the state of the art of ML models used in energy systems along with a novel taxonomy of models and applications. Through a novel methodology, ML models are identified and further classified according to the ML modeling technique, energy type, and application area. Furthermore, a comprehensive review of the literature leads to an assessment and performance evaluation of the ML models and their applications, and a discussion of the major challenges and opportunities for prospective research. This paper further concludes that there is an outstanding rise in the accuracy, robustness, precision and generalization ability of the ML models in energy systems using hybrid ML models. Hybridization is reported to be effective in the advancement of prediction models, particularly for renewable energy systems, e.g., solar energy, wind energy, and biofuels. Moreover, the energy demand prediction using hybrid models of ML have highly contributed to the energy efficiency and therefore energy governance and sustainability. © 2019 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).</p>	Exclude	energy
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30	Lu Y.	Blockchain and the related issues: a review of current research topics	2018	<p>The blockchain represents emerging technologies and future trends. For the traditional social organization and mode of operation, the development of the blockchain is a revolution. As a decentralized infrastructure and distributed general ledger agreement, the blockchain presents us with a great opportunity to establish data security and trust for automation and intelligence development in the Internet of Things (IoT) and it creates a new un-centralized programmable smart ecosystem. Our research synthesizes and analyses extant articles that focus on blockchain-related perspectives which will potentially play an important role in sustainable development in the world. Blockchain applications and future directions always attract more attention. Blockchain technology provides strong scalability and interoperability between the intelligent and the physical worlds. © 2018, © 2018 Antai College of Economics and Management, Shanghai Jiao Tong University.</p>	Include	the related issues
31	Truby J.	Decarbonizing Bitcoin: Law and policy choices for reducing the energy consumption of Blockchain technologies and digital currencies	2018	<p>The vast transactional, trust and security advantages of Bitcoin are dwarfed by the intentionally resource-intensive design in its transaction verification process which now threatens the climate we depend upon for survival. Indeed Bitcoin mining and transactions are an application of Blockchain technology employing an inefficient use of scarce energy resources for a financial activity at a point in human development where world governments are scrambling to reduce energy consumption through their Paris Agreement climate change commitments and beyond to mitigate future climate change implications. Without encouraging more sustainable development of the potential applications of Blockchain technologies which can have significant social and economic benefits, their resource-intensive design combined now pose a serious threat to the global commitment to mitigate greenhouse gas emissions. The article examines government intervention choices to desocialise negative environmental externalities caused by high-energy consuming Blockchain technology designs. The research question explores how to promote the environmentally sustainable development of applications of Blockchain without damaging this valuable sector. It studies existing regulatory and fiscal policy approaches towards digital currencies in order to provide a basis for further legal and policy tools targeted at mitigating energy consumption of Blockchain technologies. The article concludes by identifying appropriate fiscal policy options for this purpose, as well as further considerations on the potential for Blockchain technology in climate change mitigation. © 2018 Elsevier Ltd</p>	Include	bitcoin

32	Hou J., Wang H., Liu P.	Applying the blockchain technology to promote the development of distributed photovoltaic in China	2018	Access to energy has increasingly been provided by the Chinese Government via new alternative energy sources known as renewables in recent years. Meanwhile, the development and use of environmentally friendly renewables gradually become the basic requirements for the sustainable development in the future society. The integration of blockchain technology with distributed photovoltaic (PV) energy may break the existing pattern where the production, transportation, distribution, and sales of energy are centralized. This paper first reviews the current overall situation of China's distributed PV and further analyzes the policy environment with respect to the development of distributed PV. On the basis of the analysis of the status quo, the paper then discusses the internalities (strengths and weaknesses) and the externalities (opportunities and threats) that have driven the development of China's distributed PV by illustrating the SWOT analysis. The data structure and characteristics of blockchain are analyzed to identify the application mode of blockchain technology in the distributed PV industry for the first time. Through our research, some conclusions and policy proposals are finally put forward to provide support to the formulation of related policy in the Chinese Government and industry association. Copyright © 2018 John Wiley & Sons, Ltd.	Include	Renewable
33	Giungato P., Rana R., Tarabella A., Tricase C.	Current trends in sustainability of bitcoins and related blockchain technology	2017	Bitcoin is a digital currency based on a peer-to-peer payment system managed by an open source software and characterized by lower transaction costs, greater security and scalability than fiat money and no need of a central bank. Despite criticisms about illegal uses and social consequences, it is attracting the interest of the scientific community. The purpose of this work is to define and evaluate the current trends of the literature concerned with the sustainability of bitcoin, considering the environmental impacts, social issues and economic aspects. From the analysis it emerges that the transition of the whole monetary system in the new cryptocurrency will result in an unacceptable amount of energy consumed to mine new bitcoins and to maintain the entire virtual monetary system, and probably bitcoin will remain a niche currency. Blockchain, which is the base for a distributed and democratically-sustained public ledger of the transactions, could foster new and challenging opportunities. Sharing the framework of medical data, energy generation and distribution in micro-grids at the citizen level, block-stack and new state-driven cryptocurrencies, may benefit from the wide spread of blockchain-based transactions. Under the perspective of its being a driver of social change, bitcoins and related blockchain technologies may overcome the issues highlighted by numerous detractors. © 2017 by the authors.	Include	bitcoin
34	Vranken H.	Sustainability of bitcoin and blockchains	2017	Bitcoin is an electronic currency that has become increasingly popular since its introduction in 2008. Transactions in the bitcoin system are stored in a public transaction ledger ('the blockchain'), which is stored in a decentralized, peer-to-peer network. Bitcoin provides decentralized currency issuance and transaction clearance. The security of the blockchain depends on a compute-intensive algorithm for bitcoin mining, which prevents double spending of bitcoins and tampering with confirmed transactions. This 'proof-of-work' algorithm is energy demanding. How much energy is actually consumed, is subject of debate. We argue that this energy consumption currently is in the range of 100–500 MW. We discuss the developments in bitcoin mining hardware. We also briefly outline alternative schemes that are less energy demanding. We finally look at other blockchain applications, and argue that also here energy consumption is not of primary concern. © 2017 Elsevier B.V.	Exclude	bitcoin