STM JOURNALS

Recent Trends in
Electronics & Communication Systems

ISSN: 2393-8757
Volume 12, Issue 1, 2025
January–April
DOI (Journal): 10.37591/RTECS

https://journals.stmjournals.com/rtecs

Review RTECS

Big Data Application in Manufacturing and Supply Chain Management: A Comprehensive Review

Krish Patel[1], Karan R. Talwalkar[1,*], Dhaval Powle[1], Kshitij Navale[1]

Abstract

This review paper synthesizes findings from ten recent studies on the application of big data analytics in manufacturing, supply chain management, and related fields. The papers examined cover a range of topics including sustainable manufacturing, green supply chain management, predictive maintenance, and semiconductor manufacturing. This review aims to provide a comprehensive overview of the current state of research in these areas, highlighting key trends, methodologies, and opportunities for future work. With this scenario, a synthesis of a variety of data acquired with time including data from sensors, machines, customers, and the market is possible and even real-time. The objectives of this literature review are fivefold, and to locate and articulate the use of big data in ten recent studies involving manufacturing and supply chain management applications of such data. This interdisciplinary compact proposes to address the status of research in the area by exploring a range of topics related to sustainable manufacturing systems development, green supply chain, condition-based maintenance, and semiconductor industry management.

Keywords: Manufacturing, big data analytics, supply chain, RED Tag

INTRODUCTION

Society refers to the fourth industrial revolution as 'Industry 4.0,' due to the technological progress that society has made from the use of digital technology and relates to information, biological, and physical objects. This industrial revolution has resulted in a sizable increase in the generation of data and the ways in which this data is being used.

This is also perceived in the manufacturing and supply chain management industry, where the adoption of big data analytics delivers transformational changes to traditional approaches, efficiencies, new opportunities, and even sustainability and innovations [1]. Big data is a testimonial in social analysis owing to its volume, velocity, variety, and veracity. Manufacturing and Supply chain management are examples of specific industries, such as the context of this study. How this piece of equipment operates is simple and multifarious:

***Author for Correspondence**
Karan R Talwalkar
E-mail: karantalwalkar@gmail.com

[1]Student, Shri Vile Parle Kelavani Mandal's Narsee Monjee Institute of Management Studies, Thane, Mumbai, Maharashtra, India

Received Date: December 17, 2024
Accepted Date: December 20, 2024
Published Date: December 27, 2024

Citation: Krish Patel, Karan R. Talwalkar, Dhaval Powle, Kshitij Navale. Big Data Application in Manufacturing and Supply Chain Management: A Comprehensive Review. Recent Trends in Electronics & Communication Systems. 2025; 12(1): 8–17p.

Improved Decision Making

Big data analytics ensure that all decision-makers are supported with diagnosis and action-oriented predictive and proactive analytical tools, and the right decisions on time are made and slipped through time are diminished all through the value chain [2].

Optimized Business Processes

As big data helps in tracing the trends and deviations among the various tasks being performed during production operations, it helps in reducing the operational costs at stake [3].

Preemptive Repair

The capacity to predict and diagnose the defects in the machinery will ultimately help to ensure that they are not broken, providing without interruptions, hence saving money [1, 5].

Supply Chain Visibility

Further, big data offers great support in managing complex and global supply chains and ensures faster control of the risks and addressing of risks [4].

Energy Policies

By employing big data, it is now possible to continuously measure and regulate energy and fuel consumption and emissions to engage in more energy-friendly products within a manufacturing and logistics setting [2, 6].

Customer-Centricity

Subsequent analysis of customer-related data supports a shift towards offering more customized goods and services and accurate predictions of customer demand [7].

Notwithstanding these transformative potentials, big data usage within manufacturing and supply chains is not without issues. Data quality, privacy, security, and the availability of personnel and infrastructure are some of the main barriers [1].

The scope of this review and its objectives are threefold:

- To identify the major changes brought about by big data in the areas of manufacturing and supply chain management.
- To assess similar issues, approaches, and concerns that are presented through these different applications of big data available in these sectors.
- To identify the shortcomings of existing studies and provide appropriate areas in which these studies need to be conducted in the future.

This review is of particular importance in the emerging big data context to help orient researchers, practitioners, and policymakers who may be overwhelmed by the plethora of big data applications and the many possible tools available. In doing so, we seek to transcend the review of the most recent studies and contribute towards a more comprehensive understanding of how the concept of ‘big data’ can be strategically utilized towards the creation of more effective, cleaner, and more robust industrial ecosystems in the future.

BIG DATA IN SUSTAINABLE MANUFACTURING AND SUPPLY CHAIN MANAGEMENT

The use of big data in processes such as sustainability in manufacturing and supply chain management reflects drastic changes in the operational and environmental aspects of industries. This section concerns emerging areas where the complementary characteristics of big data substantially enhance sustainability agendas.

Sustainable Manufacturing Frameworks

The emergence of big data technology has changed the practices utilized for achieving sustainable manufacturing, in that dependencies, monitoring, analysis, and optimization are at unprecedented levels. A concept relaxation approach toward succession strategies for digital concept structures of two or more production topics has been introduced [8]. This system takes advantage of the predictive setting in which data are collected during the course of running the machines, thus preventing failures instead of responding to them when they occur.

The conceptualization of this big-data-made system has several key impacts.

1. *Predictive Maintenance:* By comparing and analyzing existing sensor data, manufacturers can easily predict when a particular piece of equipment is likely to fail, thus limiting downtime and increasing the operational life span of machinery.

2. *Energy Optimization:* Effective monitoring of energy utilization patterns in real-time helps monitor production performance and enables modification of activities that waste energy.
3. *Quality Enhancement:* The monitoring of the production system using data is paramount as it helps in monitoring the small factors that, in one way or the other, invaded the product out and many materials were lost in vain.
4. *Life Cycle Assessment:* It is possible to conduct life cycle assessments of a wider scope thanks to big data, which allows for better leadership in design for sustainability from the extraction of raw materials through the eventual disposal of the product.

The introduction of such frameworks brings considerable advancement towards the provisions of the United Nations' Sustainable Development Goals, especially Goal number 9 (Industry, Innovation, and Infrastructure) and Goal number 12 (Responsible Consumption and Production).

Green Supply Chain Management

The integration of game theory with big data analytics is proving revolutionary to green supply chain management (GSCM) practices. A new way of looking at supply chains that incorporates cost-sharing models in the context of big data has appeared within supply chain management [2] and adds to current knowledge regarding environmental supply chain practices.

This novel strategy provides more than one favorable result, some of which are

1. *Collaborative Sustainability:* Big data helps determine the most suitable cost-sharing mechanisms that encourage all members of the supply chain to go green and stay there.
2. *Risk Mitigation:* The availability of advanced analytics assists in the risk assessment of environmental degradation and the degree of destruction it can cause to the supply chain, putting preventive measures in place.
3. *Supplier Evaluation:* Owing to big data, suppliers can be assessed more thoroughly and innovatively through the application of sustainability performance in real-time in a bid to encourage racing to the top rather than racing to the bottom.
4. *Carbon Footprint Reduction:* Following the investigation of transportation and logistics information available by the company, more optimal transportation routes and transport modes can be used to reduce carbon footprints.

The combination of game theory and big data technology in Global Supply Chain Management represents new opportunities to overcome the problem of contemporary supply chains being economically rational but environmentally irresponsible, which will undoubtedly hasten the development of real sustainable supply chains.

Big Data Analytics and Supply Chain Planning

The relationship between big data analytics and supply chain planning enhances the ways businesses predict demand, control stock levels, and cope with changes in the environment. As indicated in a recent study, the advantages of this integration are enormous and worth exploring.

Some of the areas of impact include:

1. *Demand Forecasting:* Organizations make use of many non-traditional sources of information, such as social networks, weather information, and economic status, enabling their demand forecasting to become more accurate and minimizing the over-production problem.
2. *Inventory Optimization:* With big data, it is possible to determine the amount of inventory available at different locations in the supply chain structures at any given moment, which allows for nimble inventory reduction strategies.
3. *Supplier Network Optimization:* Complex modern analytics allow for addressing various risks in a supplier network and achieving comprehensive optimization. Factors such as location risks, supplier environmental sustainability policies, and other disruptions were considered.

4. *Circular Economy Initiatives:* The use of big data makes it possible to adopt circular economy strategies in supply chains by helping monitor products and find ways to reuse, repair, or recycle products.

The combination of big data analytics with supply chain planning not only improves operational processes but also changes the scope of what can be achieved by developing strong, robust, and responsive supply chains.

Internet of Things and Big Data in Smart Supply Chains

The relationship between big data analytics and supply chain planning enhances the ways businesses predict demand, control stock levels, and cope with changes in the environment. As indicated in a recent study, the advantages of this integration are enormous and worth exploring.

Some of the areas of impact include:

1. *Demand Forecasting:* Organizations make use of many non-traditional sources of information, such as social networks, weather information, and economic status, enabling their demand forecasting to become more accurate and minimizing the over-production problem.
2. *Inventory Optimization:* With big data, it is possible to determine the amount of inventory available at different locations in the supply chain structures at any given moment, which allows for nimble inventory reduction strategies.
3. *Supplier Network Optimization:* Complex modern analytics allow for addressing various risks in a supplier network and achieving comprehensive optimization. Factors such as location risks, supplier environmental sustainability policies, and other disruptions were considered.
4. *Circular Economy Initiatives:* The use of big data makes it possible to adopt circular economy strategies in supply chains by helping monitor products and find ways to reuse, repair, or recycle products.
5. The combination of big data analytics with supply chain planning not only improves operational processes but also changes the scope of what can be achieved in developing strong and robust.

The integration of Internet of Things (IoT) and big data in supply chains is not just a technological advancement; it is a fundamental reimagining of how goods and information flow with sustainability at its core.

BIG DATA IN SEMICONDUCTOR AND DISCRETE MANUFACTURING

Owing to the complexity and precision demanded by these activities, semiconductor and discrete manufacturing industries have a great chance of utilizing big data. These industries use high-end technologies in analytics to enhance productivity, improve the quality of services and products, and promote sustainability. In this section, we examine two areas in which big data has a significant impact on high-tech manufacturing settings.

Yield Enhancement in Semiconductor Manufacturing

The semiconductor industry stands out as such applying big data and its vast analytics solves various constraints since manufacturing of semiconductors requires super-fine measurements at the nanoscale as well as many steps carried out in parallel.” There is growing interest in the development of systems for improving yields in semiconductor manufacturing cultures with the provision of advanced technologies, demonstrating the breadth of new solutions that analytics can bring to this critical area of industry.

Key impacts and innovations include:

1. *Real-Time Process Control:* The data analytics of big data offers monitoring and control of potentially hundreds of parameters in real-time, regardless of the stations of the manufacturing process as chores. Such granular exploitation of real-time resolution for controlling processes has not been experienced before; hence, quick changes to maintain the maximum yield value can be made.

2. *Predictive Defect Detection:* After obtaining such historical and current data, any manufacturer is capable of foreseeing a probable defect before it occurs. This unique approach reduces the waste of materials and enhances the total yield.
3. *Equipment Health Monitoring:* Utilization of advanced analytics, there is the possibility of effective equipment monitoring in operation, and on the basis of this health prognosis, maintenance work has been scheduled.
4. *Root Cause Analysis:* Big data approaches can be used to rapidly investigate the reasons for the yield loss so that the resources and the time used in addressing problems are reduced.
5. *Design for Manufacturability:* The information learned from big data analytics is provided back to the design process, allowing for chip designs that are more manufacturable and capable of achieving higher yield rates.
6. *Supply Chain Integration:* Big data ensures that there is integration between semiconductor manufacturers and suppliers so that there is no delay in the provision of material and equipment required for the operation.

The influence of these advances is not restricted to the semiconductor industry. Hence, improvements in yield and efficiency that may occur in these industries will have tremendous positive effects in any field where semiconductors are used, including the mobile device, automotive, and healthcare industries.

Carbon Efficiency Evaluation in Discrete Manufacturing

With the rise in environmental awareness, the discrete manufacturing sector is taking measures to embrace big data to ensure sustainability. [6] has brought out a revolutionary big data analysis to evaluate carbon efficiency in real-time for discrete manufacturing workshops. This study explores how descriptive and predictive aspects of advanced analytics reporting may be utilized to control energy consumption and carbon emissions in manufacturing processes.

The implications of this approach are numerous:

1. *Monitoring of Emissions in Real-Time:* As evident in this study, carbon emissions throughout the entire manufacturing process can be continuously monitored because of big data, which greatly extends the capability and reach of such environmental endeavors.
2. *Optimization of Energy Consumption:* The analysis of energy usage enables manufacturers to understand the patterns of energy and minimize unnecessary energy usage.
3. *Redesigning Processes with Energy-Efficient Technologies:* Big data analytics provide information that guides the redesign of processes to reduce energy consumption and reduce carbon emissions to improve efficiency, productivity, and sustainability.
4. *Modeling of Environmental Impact:* Through advanced analytics, some manufacturers are considering carrying out a modeling exercise on the possible impacts that particular or changes in particular production processes or productions may have on the environment before that change is implemented.
5. *Well-tracked carbon footprint analysis throughout a product's life cycle:* The use of big data permits tracing the carbon emissions of a product, including its sourcing of raw materials, manufacturing, use, and disposal at the end of the life cycle, allowing enhanced lifecycle assessments.
6. *Compliance and Regulation:* Bands monitoring and analyzing virtually in real-time makes regulatory requirements and environmental reporting, plus the usual associated costs and risks, less cumbersome.

Collaboration with suppliers and customers Towards Supply Chain Enhancement: When manufacturers make available carbon efficiency statistics for their suppliers' customers, green policies can be pursued by the manufacturers in the value chain. Such a carbon efficiency big data approach should not be seen only as an environmental obligation; it also poses considerable economic benefits. With various countries adopting carbon pricing, manufacturers who can control how they emit excessive gases and reduce their emissions will be more favorably placed. With respect to the latter, the knowledge gained inside these applications in discrete manufacturing can also be utilized in sustainable activities towards other industrial areas for climate change mitigation and low-carbon economic transformation.

It is an industrial revolution in which big data is fused with the semiconductor and discrete manufacturing industries. It not only promises to improve the productivity and quality of such industries but also brings them to the vanguard of environmentally friendly manufacturing. As these technologies graduate and find synergies, we can look forward to more applicable applications that can change the manufacturing domain in a better and more sustainable manner.

PREDICTIVE MAINTENANCE AND ANALYTICS

Predictive maintenance, enabled by big data analytics, is changing the way industries upkeep equipment and exude operational efficiency. By utilizing a large volume of sensor data and modern analytical methods, organizations can now predict and avert equipment breakdowns before they occur, thus enhancing reliability, cutting costs, and improving total operational efficiency. In this section, we review two aspects in which predictive maintenance and analytics work to bring the most steam.

Predictive Maintenance in Parcel Delivery

The alertness of a system, along with its controlling techniques, makes it possible to connect the sturdy and complex networks of vehicles and distribution centers to a predictive maintenance approach. A new predictive maintenance methodology called risk evaluation detection (RED) Tag has been developed specifically for use in delivery services [7]. This original construct shows instances of maintenance that, through data analytics, can be overhauled in demanding and critical time-framed industries.

Key contributions and advancements of the RED Tag framework are as follows:

1. *Fleet Optimization:* With the input of the vehicle sensors, GPS, and the use of historical vehicle maintenance records, RED Tag uses the data and analyzes it to show the probable breakdown of the vehicles used in delivery. This enables maintenance management to schedule maintenance in an anticipatory manner, thereby reducing the chances of breaking down and maximizing fleet readiness.
2. *Cost Reduction:* The implication of predictive maintenance is a decrease in expenditure related to unplanned vehicle breakdown, vehicle repair, and twiddling vehicles due to idle time. This increases the efficiency of vehicles and minimizes the replacement cost to an upward level.
3. *Service reliability Enhancement:* REDTag makes it possible to minimize the frequency of delivery vehicle breakdowns during progressive deliveries and hence ensures service reliability, which is important in the aggressively competitive package delivery industry.
4. *Dynamic Maintenance Scheduling:* The underlying structure is such that within the confines of the framework, datasets are used to develop a maintenance strategy that is flexible and responsive, as opposed to the conventional panel of schedules that fix certain periods for maintenance.
5. *Driver Safety Improvement:* The fault RED Tag is aimed at resolving the deteriorating state of vehicles, which is a significant driver in ensuring driver safety and the risk of vehicle faults causing accidents as well.
6. *Environmental Impact Reduction:* A neglected vehicle is more likely to waste fuel and produce greenhouse gases. Some factors are not within the company's operations; the RED Tag helps ensure that the delivery fleet is in its optimum shape, thus helping to mitigate those issues.
7. *Predictive Inventory Management:* This level of the system is capable of predicting parts and components that will most probably be required in various maintenance activities scheduled for the future and refilling stocks of spare parts only when necessary.

The introduction of such pipeline maintenance methods in postal delivery services demonstrates the capacity of redundancy management to meet the needs of industries. The focus on stronger e-commerce trends underlines the increasing importance of being able to maintain efficient and reliable delivery fleets, which makes such innovations as the RED Tag likely to change the logistics industry.

Big Data Analytics in Smart Manufacturing

The area of big data analytics for maintenance is, of course, not restricted to logistics but cuts into the very bowels of the manufacturing process. Previous studies on the analytics of big data for smart manufacturing within semiconductor industries [9] have demonstrated beyond reasonable doubt the most promising transformations of these technologies in high-precision manufacturing ecosystems.

Big data analysis in smart manufacturing increases efficiency gains in far and wide ways.

1. *Reduction in Equipment Downtime:* It is possible to predict such failures and repair the affected parts or remove the equipment prior to the occurrence of unplanned downtime by taking data from the sensors integrated into the manufacturing system equipment and analyzing the data over time, Hence the name predictive analysis. Particularly in the semiconductor industry, this impact is noteworthy because equipment downtime can cost several million dollars an hour on average.
2. *Improvement of Quality Control:* Predictive maintenance analysis is necessary when there is a slow control drift in manufacturing processes that can bring about quality concerns. Such deviations can be identified and rectified in time; therefore, consistent product quality is guaranteed.
3. *Ineffective Yield Management:* For deficiency in productivity in semiconductor manufacturing where yield is paramount, predictive maintenance ensures that optimal performance of equipment is preserved, increasing all yield and reducing wastage.[10]
4. *Energy Efficiency:* With predictive maintenance, energy is also saved in the manufacturing processes, as all the machines and production equipment run under optimal conditions.
5. *Lifespan Extension of Critical Equipment:* Predictive maintenance is instrumental both in taking great care of technologically advanced industrial machinery and maximizing the return on investment through minimal repairs and maintenance.
6. *Supply Chain Integration:* Data collected from the maintenance procedures can be attached to the systems; therefore, when the marketers need to maintain the clients, it will not be delayed owing to the lack of certain supply parts.
7. *Continuous Process Improvement:* Predictive maintenance systems generate vast amounts of data with tremendous potential. The knowledge obtained from analyzing such data assists in the continual optimization of manufacturing processes.
8. *Skilled Workforce Development:* The existence of predictive maintenance systems will warrant the requirement of a skilled workforce that is able to understand data in various formats and render case-specific solutions using such data. The paradigm of analysis of big data in smart manufacturing moves from maintenance strategies that rely solely on the occurrence of limitations to one that is engaged even before the occurrence of failure of any predetermined equipment. This shift not only enhances the maintenance practices of the company but also adds to the total sustainability and competitiveness of various manufacturing operations.

Cross-industry Implications of Predictive Maintenance

The Developments in predictive maintenance and predictive analytics with respect to the last-mile parcel movement and semiconductor manufacturing have a wide reach across other industries.

1. *Aerospace:* The use of predictive maintenance on the aircraft can improve safety, reduce the number of delays on flights, and help arrange maintenance activities more efficiently, thereby helping the airline save operational costs.
2. *Energy Sector:* In addition, predictive maintenance in plants and renewable energy facilities increases reliability, shortens activity breaks, and increases overall efficiency in energy production.
3. *Healthcare:* For instance, the use of predictive maintenance on medical devices equipped in intensive care units can enhance the operational readiness and performance of devices that are able to treat patients better than without the maintenance model.
4. *Automotive Industry:* The increasing complexity and data-rich profile of modern-day automobiles makes predictive maintenance more of a necessity in the automotive industry, leading to enhanced reliability of vehicles and greater customer satisfaction.

5. *Infrastructure:* The predictive maintenance of critical public infrastructure such as bridges, roads, and railway tracks are aimed at averting the occurrence of catastrophic events, minimizing maintenance costs, and enhancing public safety.

Ideas, philosophies, and methodologies for predictive maintenance from those established for different sectors innovatively redefine and create improved practices and management in asset management and operations.

In summary, industrial maintenance has undoubtedly benefited from the development of predictive analytics and big data. Such a transformation is made possible by changing the approach towards maintenance from a reactive to a more economically beneficial preventive one, which is associated with heightened efficiency in operations, decreased costs, and better performance. The rise in detection technologies and analytical processes will enable further proliferation of predictive maintenance as more efficient, and even more broadly, within organizational operations in the future.

COMPREHENSIVE REVIEWS AND FUTURE DIRECTIONS

Big data analytics is expanding the horizons of the manufacturing and supply chains. This review attempts to fuse the core issues and assess future research and development.

Challenges and Opportunities in Industrial Big Data

The errors refer to the following issues.

1. *Data Integration:* The continuing challenge of fusing structured and unstructured data remains owing to the need for strong frameworks.
2. *Data Quality and Reliability:* Owing to technological advancements in the generation of large amounts of data, advanced cleansing techniques are necessary.
3. *Real-time Processing:* The industrial use of analytics imposes the demand for newer and better platforms.
4. *Security and Privacy:* There is an increased need for better security when data is shared across organizations.
5. *Skills Gap:* There is a significant shortage of professionals in the big data line, which triggers the need for education aimed at this market.
6. *ROI Quantification and Scalability:* To be easily adopted, there is a need for accurate ways of measuring returns on investment and scaling solutions.

Supply Chain Demand Forecasting

Demand forecasting also benefits from big data, with such positive outlooks:

1. *External Data Integration:* Enhancements in accuracy will be realized by integrating social, environmental, and economic data into the spheres of stylistics.
2. *Artificial Intelligence and Machine Learning:* Global supply chains will be improved through the application of advanced AI techniques, including deep learning.
3. *Real-time Capabilities:* Forecasting in a timely manner and in real-time must change for dynamic supply chains to work.
4. *Model Interpretability and Uncertainty:* Integrated development of more transparent models and better uncertainty levels will lead to better decisions.
5. *Sustainability and Cross-functional Integration:* Redesigning sustainability measures and increasing interactions with diverse business functions can foster a wider ecosystem.

Emerging Trends and Future Directions

Key highlights include:

1. *Edge Computing and IoT:* Decisions made in real-time will take edge computing as an advantage in places where IoT exists in plenty.
2. *Artificial Intelligence and Machine Learning Synergy:* Advanced analytics have been made possible owing to the data related to operations being combined with artificial intelligence.

3. *Digital Twins and Blockchain:* By Using simulation and digital twins together with blockchain, security, trust, and efficiency of operations will be increased.
4. *Quantum Computing:* This promising technology can potentially eliminate serious problems in solving complicated optimization problems.
5. *Human–Artificial Intelligence Collaboration and Sustainability:* Interaction between humans and artificial intelligence progresses performance and so does big data towards a sustainable economy.

The term “Big Data” has been tagged to certain solutions, which will bring about exceptional transformation and effectiveness in the world’s manufacturing and supply chain. The second source of barriers is technical, security, and skilled workforce. The road ahead is rocky; however, the rewards are human, ecological, and economic.

CONCLUSION AND FUTURE RESEARCH DIRECTION

This review shows that big data has a significant impact on manufacturing and supply chain management. The analyses undertaken illustrate several key points, including the following.

1. Such analytics are transforming green manufacturing, green supply chains, predictive maintenance, and demand forecasting practices.
2. Time-sensitive information can be analyzed in seconds, and rapid adjustments can be made within a short span of time to strategic plans or operational actions in factory settings.
3. However, data interoperability, data quality, and lack of a skilled workforce remain difficult issues.
4. Privacy, security, and ethical issues become even more crucial as industrial systems are more linked to each other.

Suggestions for future research should aim at:

1. More sophisticated implementations of artificial intelligence and machine learning in industries.
2. Edge computing and IoT are used for the collection of data from the field in real-time to analyze it.
3. Procuring realistic digital twins of sophisticated manufacturing systems.
4. Use of big data to promote sustainable practices and effective circular economic strategies.
5. Systems that encourage safe and ethical sharing of data across different industries.
6. Human intelligent agents and human-computer symmetry as applied in industries.
7. Evaluative systems that centralize predictive maintenance with regard to cumulative systematic performance.
8. The exploitation of big data in risk management and enhancing supply chain readiness.
9. Uses of quantum computing in alleviating some of the difficult industrial operation optimization problems.
10. Ethical and social aspects related to data-driven transformations in the information society.

Implementing big data, along with the available and relevant workplace technology in manufacturing and supply chain activities, has been a quantum leap in the corresponding industrial activities. While the obstacles are substantial, efficiency, green effects, and creativity are remarkable. During this evolution, we should be careful so that advancement does not differ from the desires of the values of technology. Every person needs to work towards an era in which the manufacturing and management industries of supply chains are increasingly reliant on technology, with careful efforts towards making the future of all stakeholders healthy, moral, and advantageous.

REFERENCES

1. Kumar A, Shankar R, Thakur LS. A big data driven sustainable manufacturing framework for condition-based maintenance prediction. J Comput Sci. 2017;27:428–39.
2. Esmaeeli Z, Mollaverdi N, Safarzadeh S. A game theoretic approach for green supply chain management in a big data environment considering cost-sharing models. Expert Syst Appl. 2024;257:124989. doi: 10.1016/j.eswa.2024.124989.

3. Xu J, Pero M, Fabbri M. Unfolding the link between big data analytics and supply chain planning. Technol Forecast Soc Change. 2023;196:122805. doi: 10.1016/j.techfore.2023.122805.
4. Pratap S, Jauhar SK, Gunasekaran A, Kamble SS. Optimizing the IoT and big data embedded smart supply chains for sustainable performance. Comput Ind Eng. 2024;187. DOI: 10.1016/j.cie.2023.109828.
5. Nakata K, Orihara R, Mizuoka Y, Takagi K. A comprehensive big-data-based monitoring system for yield enhancement in semiconductor manufacturing. IEEE Trans Semicond Manuf. 2017;30:339–44. DOI: 10.1109/TSM.2017.2753251.
6. Zhang C, Ji W. Big data analysis approach for real-time carbon efficiency evaluation of discrete manufacturing workshops. IEEE Access. 2019;7:107730–43. DOI: 10.1109/ACCESS.2019.2933353.
7. Proto S, Di Corso E, Apiletti D, Cagliero L, Cerquitelli T, Malnati G, Mazzucchi D. REDTag: A predictive maintenance framework for parcel delivery services. IEEE Access. 2020;8:14953–64. doi: 10.1109/ACCESS.2020.2966568.
8. Sarker S, Arefin MS, Kowsher M, Bhuiyan T, Dhar PK, Kwon OJ. A comprehensive review on big data for industries: Challenges and opportunities. IEEE Access. 2023;11:744–69. doi: 10.1109/ACCESS.2022.3232526.
9. Moyne J, Iskandar J. Big data analytics for smart manufacturing: Case studies in semiconductor manufacturing. Processes. 2017;5. DOI: 10.3390/pr5030039.
10. Seyedan M, Mafakheri F. Predictive big data analytics for supply chain demand forecasting: Methods, applications, and research opportunities. J Big Data. 2020;7(1):53. doi: 10.1186/s40537-020-00329-2.

