

CONSUMER RETAIL INDUSTRY AND PROFITABILITY: THE ROLE OF ANALYTICS

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Abstract

As the retail industry gets extensively competitive, the ability to optimize business processes while gratifying customer expectations has never been more essential. Consequently, managing and channelizing info to work to client delight & generate whole revenue is crucial to survive prosperously. In the circumstance of big show players globally and in America, info or perhaps rather big data analytics is now used for every phase of the show progression, tracking emerging items which are common, forecasting potential sales and demand through predictive simulation, optimizing product placements and offers by customer heat mapping, and several others. Alongside this specific, determining the customers are extremely prone to be sharp on certain merchandise sorts based on their prior actions, working out the easiest technique to target them through certain marketing initiatives, and finally working out what to advertise them following will be the point that forms the middle of data analytics. This particular statement will be the product of a descriptive exploration of yesteryear, present and future of the retail industry, and the application of business analytics in shaping suitable marketing methods.

Keywords

Smart Retail, Machine learning.

JEL Classification

M38, M41

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Introduction

Along with the present promise of delivering performance upgrades not experienced following the improvement of main operations in the 1990s, these tools will likely change the competitive landscape in many industries in the years to come [five]. Big Information is about the non traditional ways of dealing with contemporary electronic data. We're contained in an ocean of electronic info. It offers info stored in heaps of well organized databases residing with companies, channels of info created out of the effective social networking websites, various understandable in addition to intangible signals created by all kinds of electronic equipment all across the school.

For an enterprise, Big Data might be about identifying the appropriate datasets from great quantities of info ordinarily outlined by the three Vs Volume, Velocity and Variety; modifying them into quickly consumable models; and also then extracting considerable insights for devising company techniques [nine]. These insights could be used to improve different facets of the company at marketing and sales, to explore operations and customer services. Large Data allows clientele in the summary industry to look at and far better comprehend a lot of information from various sources of energy, such as CRM, AdWord/AdSense analytics, inventory management process, emails, transactional data, receptors info etc. Business can determine the current fashion, re buy provides for hot selling products, change the fees on time which is genuine, and also regulate along with management product distribution throughout different outlets to channelize their sales in a more effective manner [ten]. This has shown market with different perspectives on the datasets provided in their disposal. By collating these organizational datasets with social media info channels, they're competent to similarly set it to use for far better product sales predictions, establishing associated promotions to fit their lucrative clients, ensuring customer satisfaction [eight].

Literature Review

Enterprise Analytics is some strategies and methods which could be used to analyze info to enhance business effectiveness through point-based decision making [three]. It is the subset of Business Intelligence, which allows small businesses to get involved correctly on the marketplace. Enterprise Analytics is becoming among numerous main sensible components in many businesses. Vendors acquire the power to allow their choices via analytic reasoning [two]. Thomas Devonport in the book "Competing on Analytics: The completely new science of winning", claims that a significant proportion of high end companies have tall analytical capabilities of all their personnel. On the other hand, a recently accessible study has also revealed that more than 50% of organizations do not have information needed for decision-making [six].

In a recently accessible article, depending on the survey of nearly 3000 executives, MIT Sloan Management Review found that there is a striking correlation between an organization's analytics sophistication and its competitive functionality. The biggest hurdle to adopting analytics will be the lack of know-how to enhance business effectiveness. Enterprise Analytics uses statistical, operations research and management tools to drive company effectiveness [seven]. Data Analytics today has discovered its application in various fields across the industry. Nowadays, it's used for strategic, operational and also tactical decision-making projects, throughout various company verticals. These

range from Retail, E-commerce, Banking, Finance, Healthcare, Sports and Manufacturing among others [four].

American Retail Industry

Supported by powerful fiscal growth and rising family incomes, consumer spending in America is expected to touch \$1dolar1 3.6 trillion by 2020, improving America's share in global use to 5.8% - much more than two times its current amounts. By 2020, America's retail business is expected to work to 1dolar1 1.2 trillion from 1dolar1 630 billion in 2015, at a compound annual growth rate of 12 %, says a joint report titled "Shaping Consumer Trends" released by FICCI in addition to consultancy Pricewaterhouse Coopers. The report's projections suggest that the standard household income in America will triple to 1dolar1 18,500 in 2020, from 1dolar1 6,400 in 2010 - acting as a tremendous driver of record growth and leading to evolution of various buyer sections. Customers are becoming more seasoned, driving firms to focus on good quality products, the article stated. Increasing disposable income levels plus a soaring number of complex clients have given rise to clients seeking premium items [eleven]. Based on IMRB's Kantar World panel report published in 2013, nearly 50% of the entire length of innovative launches in the personal focus class consistently focus on the good quality sector. The report highlights the development in the list, equally structured brick-and-mortar shops will fuel business, in addition to ecommerce.

America's show opportunity is significant, plus a solid development of e commerce is anticipated due to a sector dividend plus soaring web penetration. approximately 32.8 million people, accounting for about 25.4 % of the population, use Internet in America, dependent on electric information, in addition to analysis company eMarketer. The statement actually observed an alteration of the focus of e commerce players towards their own personal labels. The statement said that specific labels make up 10% of the total revenues of e-commerce companies. In 2015, the internet food platform Big Basket, which provides fresh fruit, vegetables, white meat, pulses and spices below its personal brand, produced 30% of its revenues from specific labels. According to the article, the e commerce business is expected to attain 1dolar1 125 billion in terminology of yucky merchandise valuation by 2020, developing in the pace of 30 one %. GMV may be the total worth of things offered with a stretch of time, without accounting for offers or perhaps goods sales returns [twelve]. The statement further says the loaded consumer products sector will cross the hundred dollars billion mark by 2020, creating an acceleration of 18 %.

Quick macroeconomic, market place and lifestyle shifts in the country clearly point towards exponential growth of the loaded products market [thirteen]. These shifts, bolstered by regulatory policy and changes, have an effective chance of taking America towards the aim of its acquisition of the biggest buyer market together with the next 10 years. According to the article, top consumer spending is likely to take place in correspondence segments, household, transport, and food. Company professionals believe that with plenty of GST and investment initiatives which came into effect by July 2017, there is a high probability of foods processing. Led by options of the area, ITC has invested nearly twenty five dollars billion in approximately 60 5 plans, a good deal of which appears to remain with food processing [fifteen].

Changing Consumer Behavior in Retail Industry

It is expected that consumer products companies are focusing on social networking channels and the internet to enter consumer's mind share as an outcome of the growing mobile internet revolution in America. Roughly 650 million people are expected to remain on the web by 2020, from which 250 million are shopping online, spending more than 50 billion dollars. Surprisingly, a minimum of 5 billion of this spending is expected to stay on packaged customer commodities [sixteen]. In the modern, technology-driven world, users or customers in the record circumstance are not only utilized to the comfortable and electronic, but also truly savvy of conditions of employing it [fourteen]. So, with respect to retail, an individual who currently has a fast-paced world is also used to instant gratification. He is not only impatient, but also aiming to feature as the beneficiary of a fantastic system.

As you will find scores of customers nowadays, there are numerous business organizations, and they're rapidly attempting to have online and overcome the sizable competition, not others like them. In the bid of theirs to maintain besides the game, it is important for each of those businesses to fully understand why the customer clicks, their likes, their dislikes, basically a 360 degree view of the buyer of theirs. This specific understanding gives them a great ground to excel at satisfying their customers, and on the other hand, attracting the appropriate sort of customers too. Analytics plays likely the most crucial role in this particular process, as it is the truly matter that drives those to understand the explanation why the customer decides, policies of the list companies. Through the various attributes it carries forward, it makes insights such as, how will an enterprise be prepared to increase margins in the product level, it also provides insights into what the customer is like, or perhaps sometimes why the customer would want to buy a certain product. This is referred to as Market Basket Analysis. The analytics help businesses similarly recognize those items, which an individual is likely to purchase in concert. What offers as well as promotions would work the truly suitable for which products and personalized has for every buyer [nineteen]. These insights are totally buyer based, but furthermore, you will find the ones that are totally company based insights. Analytics can generate the insights in terminology of how much spending a company should spend, keep sensible product mix, maximum rates which will purchase them more customers, efficient stock techniques, as well as several others.

These, little but cost-efficient insights, offer a retailer acumen regarding upcoming consumer behavior, which is typically essential to stay in the competitive retail world. This might be a far cry from the historic retailers, who simply scratched the spot when using the heaps of client info provided with them [17]. Together with the social media redefining the recommendations of the game, understanding and utilizing these social media sentiments can provide insights into the customer conduct and intentions. The formidable power of social media that could make or perhaps break makes is forcing retailers to alter the summary landscape considerably, with interactive and immediate correspondence strategies pushing away the conventional approach. Customer has actually turned into the king for retailers that will require practical expertise with unexpected customized and bespoke available products to develop an impression in the bevy of lures currently preoccupying their brains. The cases of eBay, Amazon, along with lots of others, who may have successfully reaped great benefits of data analytics, confirm that retailers, big and small, would likely be prepared to harness the great benefits of analyzing not only organized, but also unstructured information on client conduct [eighteen].

Role of business analytics in retail industry

Analytics plays an important role for business owners as they try to obtain - Positive Many Meanings - the target of knowing customers. Mobile devices have a visible spot in the increasing Internet of Things atmosphere, and businesses will also use analytics to collect the wealthy info they provide. When customers have agreed to "opt in," merchants can find a terrific offer from the way they use their equipment to interact with a manufacturer. For example, what things do they be interesting about browsing and buying? How often are purchases made and consequently exist acquiring patterns? If a shopper gets the identical bundle of infant diapers once every two days, they might like a reminder to buy, notifications of merchandise sales, or perhaps an instant purchase renewal option. Analytics provide merchants with the ability to identify these patterns and modify their offerings to better focus on owners, boosting the usefulness, customization and commerce of mobile shopping.

Nevertheless, times are changing, and gone would be the points during long range business planning. With technologies paving the way of its deep into the area, it has become vital to modify, usually perish. The conventional retail stores stay without any option but to be an element of the modification and make a dash for a wide range of reforms to attract, hold onto, and widen their customer base. With understanding the buyer developing the basis of any company strategy, it becomes the demand of the marketplace to scale up data collection, analytics, and also the use of its. A McKinsey declaration suggested retailers employing big data analytics can boost their working margins by nearly 60 every cent. The tremendously competitive list atmosphere helps it be extremely complicated to understand and also gain customers. The roadblock does not appear in the unavailability of info determining the customers, also the purchasing patterns of theirs, but rather in the accessibility of its in great volumes. The greatest issue is generally to fathom and understand the info procured from many channels to take educated company options. And this is undoubtedly the best issue, thinking about the plethora of equipment easily available to evaluate and report on info, which may not provide heavy options, making insights appropriately interpreted and also aligned on the business goals.

Many techniques where Big Data can help list businesses are: Today retailers have a more effective strategy to ascertain the customers and supply them the appropriate merchandise. The customer segmentation has turned into much more refined, along with info driven by customers transaction past, basket analysis, loyalty programs, social media interactions. Large Data management segment buyer's info to create character points, demarcating faceless mass of slots, through mastering their buying. Transaction accounts along with loyalty plans are combed through, to bring out associated details in addition to activity on it. It is easier for retailers to have a 360 degree view of the customer and supply them personalized products based on their history tendencies or perhaps what people like them are buying.

Price Optimization

Internet retailing is grounded on dynamic pricing, and the price of something depends upon a few aspects from market demand, inventory, competitors prices, whether a certain unit will be the weeks must have merchandise, etc. Data Analytics plays an important role in determining the pricing. Algorithms monitor demand, inventory levels, and competitor activity and immediately react to market

modifications in time, which is real, making it easy for action to be used grounded on insights of a time saving manner. It can help determine when expenses should be dropped - usually recognized as "mark down optimization". Prior to the era of analytics, most retailers would just reduce prices in the conclusion of a buying season for a certain service or product line, when demand has almost eliminated. But at this time, determined by Machine Learning, prices are adjusted genuine period, along with suggestions or perhaps offers are delivered to a specific range of customers who have purchased those products or perhaps have earlier found interest in buying all those.

Buyers nowadays have been getting treated royally. They truly need retailers to understand their necessity, recommend items in addition to services and that suit them, and ask them to be educated at every phase of the advertising cycle, from booking, delivery, and item distribution to feedback. This is not an easy undertaking for the retailers, keeping in mind the diverse customers they serve. Big Data Analysis can enable them to suggest the appropriate items to an individual, or perhaps come up with certain advertising campaigns to meet a particular segment. Furthermore, it enables you to realize the customers' road to purchase or perhaps the purchasing design of theirs, thus reaching out to them at each stage to turn the product sales cycle.

Now retailers have advanced gear offered to understand the fads on the market. Forecasting demand has become much more potent now. Retailers can easily discover whether a certain item is in demand throughout the year, or in a certain city or by a particular group, as well as the best way to establish the inventory. Merchants may also take a lot of info out of social media to understand the transforming preferences of customers, or perhaps do sentiment analysis to find out whether the product is getting great, negative or neutral feedback of the industry. Trend forecasting algorithms kind with the purchasing info to analyze what marketing departments have advertising and what not. Once the merchants. Use a deep insight into the buying trends of the customers. They focus on sectors where demand is high. This involves collecting marketplace, seasonal, events led economic data and indicators to produce a photograph of purchase conduct throughout the particular market. This will help listing management in a more effective way.

Identify the largest ROI Opportunities

Every customer interaction can have a huge impact on present or maybe perhaps potential interactions. Coming away with an impressive approach to the whole sales force is a risky undertaking, as an incorrect option could end up in quick and constant loss of earnings. Instead, leading industry groups have found the quickest method to isolate the cause and result link between any strategic change, in addition to performance indicators, which are crucial via a test-and-learn approach - getting an idea with a few sets of customers and analyzing the performance of the 'test' staff on the functionality of a well-matched' control' group. Immediately after obtaining a clear understanding of the possibility and existing customer base, retailers use predictive threat air filters and information driven intelligence to model anticipated replies in marketing methods, as evaluated by propensity to buy and susceptible to purchase.

The Retail Analytics Framework

An analytics framework which Positive Many Meanings merchants are competent to use to design their programs is composed of four areas: advertising, merchandising, supply chain, and shop operations.

Supply Chain Analytics

The techniques effectiveness instantly affects list profitability to enhance demand fulfillment and avoid a few backside orders or perhaps inventory outs. These have interventions in logistics, inventory and supplier performance. Complicated analytics therapies with a worldwide positioning system can help monitor the activity of the fleet, understand the behaviours of the drivers, identify hazard regions on the routes, etcetera. This may help reduce the entire expenses, make logistics more secure as well as affordable [nineteen].

Store Operation Analytics

More and more retailers are incorporating receptors to people, locations, processes and products to gather and analyze information for far better decision-making, in addition to increased transparency. Predictive analytics processes this info, improves the supply chain and lowers inventory shrink. Retail stores generally adopt sensors to build inventory levels, in addition to restock shelves instantly [twenty two]. Spot analytics are competent to map exactly how clients move through a store. By using a mix of IoT permitted items, shelf sensors, cameras, and RFID methods, one could monitor which regions of the dealer receive most traffic in typical over different hours of the day, in addition to week. Forging on, merchants can open IoT as something, allowing them to assist their consumers via new developments, including intelligent price tags, which could change prices in real time, mirrors that permit a person to try garments on nearly, and wrapping that screens the freshness of things and alerts the buyer when they are nearing the conclusion of their shelf life.

Conclusion

Merchants have started putting data analytics in the middle of their businesses during the entire value chain procurement, client management, as well as shop operations, advertising, product sales and supply chain. Nevertheless, they today need to create an enormous info environment that processes several terabytes of new details, along with petabytes of historic details, that should help them help their revenues by analytics based decision making. Although this may seem interesting, big data management and also analysis have the personal challenges. Quite a few issues will have to be stored in mind to improve the full capabilities of big data. Privacy, security, intellectual property, and also liability policies need to be strict in problems of big data. Since details that are great encapsulate excellent analytics, specially trained professionals have been getting placed into the staff members to work with and functionalize the key info.

Businesses need to incorporate info from many data resources, usually from third parties, and deploy highly effective information to help such a planet. In many cases, companies fall for shortsightedness, failing to make use of insights from analytics. , this could be repaired by continuous alterations of show

types a Nevertheless a Nevertheless specific team is allocated for function of arrangement of insights, also the implementation of theirs.

Retailing is in the base for much more information driven disruption, since the quality of info offered from internet purchases, community - community interactions, along with recently located certain smartphone interactions, have created a novice driver grouping for electric based transactions. Businesses could gain from great data management for enhanced performance, much better risk management, and also the ability to uncover insights that may otherwise be concealed [twenty three]. The use of analytics to know how customers use products and services, how to handle their staff, and determine key risks could all be beneficial for retailers. Microdata is collected at a fast rate and with great precision, giving retailers instant insight into shopping trends. Based on their previous and present purchasing habits, they can adjust their prices on the move && add additional incentive. This particular info is usually gathered in the shops by active mobile devices, which enable the retailer to understand how much they want and need, and then make smarter choices about what you should place in the shops. It's intriguing to see how information analytics have transformed over the last ten years, as analytics and data capture utilization have evolved. This particular space will continue to have when the Internet of Things expands and the society of ours gets more connected.

References

- [1] Akter Jahan, S., & Sazu, M. H. (2022). Rise of mobile banking: a phoenix moment for the financial industry. *Management & Datascience*, 6(2).
- [2] Akter, J. S., & Haque, S. M. (2022). Innovation Management: Is Big Data Necessarily Better Data?. *Management of Sustainable Development*, 14(2), 27-33.
- [3] Dutton W, et al. Clouds, big data, and smart assets: ten tech- enabled business trends to watch. *McKinsey Q* 2010;(4).
- [4] F. Ghobadi, M. Rohani, "Cost Sensitive Modeling of Credit Card Fraud using Neural Network strategy", 2016 Signal Processing and Intelligent Systems (ICSPIS), International Conference of pp. 1-5. IEEE.
- [5] Gao RX, Wang L, Helu M, Teti R. Big data analytics for smart factories of the future. *CIRP Ann* 2020;69(2):668–92.
- [6] Global Facts (2019). Topic: Startups worldwide. [online] Available at: <https://www.statista.com/topics/4733/startups-worldwide/> [Accessed 10 Jan. 2019].
- [7] Hutter, T., Haeussler, S. & Missbauer, H., 2018. Successful implementation of an order release mechanism based on workload control: a case study of a make-to-stock manufacturer. *International Journal of Production Research* , 56(4), pp. 1565-1580.
- [8] Isenberg, D. T., Sazu, M. H., & Jahan, S. A. (2022). How Banks Can Leverage Credit Risk Evaluation to Improve Financial Performance. *CECCAR Business Review*, 3(9), 62-72.
- [9] J. O. Awoyemi, A. O. Adentumbi, S. A. Oluwadare, "Credit card fraud detection using Machine Learning Techniques: A Comparative Analysis", *Computing Networking and Informatics (ICNI)*, 2017 International Conference on pp. 1-9. IEEE.
- [10] JAHAN, S. A., & Sazu, M. H. (2022). Factors Affecting The Adoption Of Financial Technology Among The Banking Customers In Emerging Economies. *Financial Studies*, 39.
- [11] Jahan, S. A., & Sazu, M. H. (2022). The Impact of Data Analytics on High Efficiency Supply Chain Management. *CECCAR Business Review*, 3(7), 62-72.
- [12] Jahan, S. A., & Sazu, M. H. (2023). Role of IoTs and Analytics in Efficient Sustainable Manufacturing of Consumer Electronics. *International Journal of Computing Sciences Research*, 7, 1337-1350.

-
- [13] Ji, W. & Wanga, L., 2017. Big data analytics based fault prediction for shop floor scheduling. *Journal of Manufacturing Systems*, Volume 43, pp. 187-194.
- [14] Ketokivi, M. & Choi, T., 2014. Renaissance of case research as a scientific method. *Journal of Operations Management*, 32(5), pp. 232-240.
- [15] Kumar, A., Shankar, R., Choudhary, A. & Thakur, L. S., 2016. A big data mapreduce framework for fault diagnosis in cloud- based manufacturing. *International Journal of Production Research*, 54(23), pp. 7060- 7073
- [16] Kusiak A. Smart manufacturing must embrace big data.
- [17] Lindström, J., Larsson, H., Jonsson, M. & Lejon, E., 2017. Towards intelligent and sustainable production: combining and integrating online predictive maintenance and continuous quality control. *Procedia CIRP of The 50th CIRP Conference on Manufacturing Systems*, Issue 63, pp. 443-448.
- [18] N. Kalaiselvi, S. Rajalakshmi, J. Padmavathi, "Credit card fraud detection using learning to rank approach", 2018 Internat2018
- [19] Nwachukwu, A. S., & Boatengu, K. E. How banks are leveraging machine learning: perspective from african banks, *business & IT*, 2022
- [20] Orlikowski, w. J. & scott, s. V. 2008. 10 sociomateriality: challenging the separation of technology, work and organization. *The academy of management annals*, 2, 433-474.
- [21] Parisi GI, Kemker R, Part JL, Kanan C, Wermter S. Continual lifelong learning with neural networks : a review. *Neural Netw* 2019;113:54–71. [https://doi.org/ 10.1016/j.neunet.2019.01.012](https://doi.org/10.1016/j.neunet.2019.01.012).
- [22] Pinsonneault, a. & kraemer, k. L. 1993. Survey research methodology in management information systems: an assessment. *Journal of management information systems*, 75- 105.
- [23] Porter, m. E. & millar, v. E. 1985. How information gives you competitive advantage. *Harvard business review*, reprint service.
- [24] process management and new technologies, 10(3-4), 9-21.
- [25] Ramaswamy, V. and Gouillart, F.J. (2010) *The Power of Co- creation: Build it with them to Boost Growth, Productivity, and Profits*, Simon and Schuster, Noida.
- [26] Rao, A. M., & rothstein, m. A. How analytics is driving the supply chain innovation in north america., *business & IT*, 2022
- [27] Santhanam, r. & hartono, e. 2003. Issues in linking information technology capability to firm performance. *Mis quarterly*, 27, 125-153.
- [28] Sazu, M. H. (2022). Does Big Data Drive Innovation In E-Commerce: A Global Perspective?. *SEISENSE Business Review*, 2(1), 55-66.
- [29] Sazu, M. H. (2022). How Machine Learning Can Drive High Frequency Algorithmic Trading for Technology Stocks. *International Journal of Data Science and Advanced Analytics (ISSN 2563-4429)*, 4(4), 84-93.
- [30] Sazu, M. H., & Jahan, S. A. (2022). Can big data analytics improve the quality of decision-making in businesses?. *Iberoamerican Business Journal*, 6(1), 04-27.
- [31] Sazu, M. H., & Jahan, S. A. (2022). HIGH EFFICIENCY PUBLIC TRANSPORTATION SYSTEM: ROLE OF BIG DATA IN MAKING RECOMMENDATIONS. *Journal of*
- [32] Sazu, M. H., & Jahan, S. A. (2022). How Analytics Can Improve Logistics And Supply Chain In Multinational Companies: Perspectives From Europe And America. *Business Excellence and Management*, 12(3), 91- 107.
- [33] Sazu, M. H., & Jahan, S. A. (2022). How Big Data Analytics Impacts the Retail Management on the European and American Markets. *CECCAR Business Review*, 3(6), 62-72.
- [34] Sazu, M. H., & Jahan, S. A. (2022). How Big Data Analytics Impacts the FMCG Management on the European and American Markets. *CECCAR Business Review*, 3(6), 62-72.
- [35] Sazu, M. H., & Jahan, S. A. (2022). How Big Data Analytics is transforming the finance industry. *Bankarstvo*, 51(2), 147-172.
-

- [36] Sazu, M. H., & Jahan, S. A. (2022). Impact of big data analytics on business performance. *International Research Journal of Modernization in Engineering Technology and Science*, 4(03), 367-378.
- [37] Sazu, M. H., & Jahan, S. A. (2022). Impact of blockchain-enabled analytics as a tool to revolutionize the banking industry. *Data Science in Finance and Economics*, 2(3), 275-293.
- [38] Sazu, M. H., & Jahan, S. A. (2022). The impact of big data analytics on supply chain management practices in fast moving consumer goods industry: evidence from developing countries. *International Journal of Business Reflections*, 3(1).
- [39] SCHULTE, R. (2000), "Application integration scenario: how the war is being won", in Gartner Group (Ed.), *Application Integration – Making E-Business Work*, Gartner Group, London.
- [40] SEUFERT, A. and Schiefer, J. (2005), "Enhanced business intelligence- supporting business processes with real-time business analytics", *Proceedings of the 16th International Workshop on Database and Expert System Applications-DEXA'05*, available at: www.ieee.org (accessed June 19, 2006).
- [41] Tao F, Qi Q, Liu A, Kusiak A. Data-driven smart manufacturing. *Int J Ind Manuf Syst Eng* 2018;48:157–69. <https://doi.org/10.1016/j.jmsy.2018.01.006>.
- [42] Wang G, Gunasekaran A, Ngai EWT, Papadopoulos T. Big data analytics in logistics and supply chain management: certain investigations for research and applications. *Int J Prod Econ* 2016;176:98–110. <https://doi.org/10.1016/j.ijpe.2016.03.014>.
- [43] Yager RR. A framework for multi-source data fusion. *Inf Sci (Ny)* 2004;163(1–3).
- [44] Zhang J. Multi-source remote sensing data fusion: status and trends. *Int J Image Data Fusion* 2010;1(1). <https://doi.org/10.1080/19479830903561035>
- [45] Zhang Y, Ren S, Liu Y, Si S. A big data analytics architecture for cleaner manufacturing and maintenance processes of complex products. *J Clean Prod* 2017;142. <https://doi.org/10.1016/j.jclepro.2016.07.123>.
- [46] Zhang Z, et al. Pathologist-level interpretable whole-slide cancer diagnosis with deep learning. *Nat Mach Intell* 2019;1(May). <https://doi.org/10.1038/s42256-019-0052-1>.
- [47] Zhong RY, Newman ST, Huang GQ, Lan S. Big Data for supply chain management in the service and manufacturing sectors: challenges, opportunities, and future perspectives. *Comput Ind Eng* 2016;101. <https://doi.org/10.1016/j.cie.2016.07.013>.
- [48] Zhu K, Li G, Zhang Y. Big data oriented smart tool condition monitoring system. *IEEE Trans Ind Inform* 2019;16(6):1. <https://doi.org/10.1109/tii.2019.2957107>.