

THE INTERNATIONAL JOURNAL OF BUSINESS & MANAGEMENT

The Application of Big Data and Artificial Intelligence in Sports Industry

Yu-Ching Lo

Lecturer, Department of Physical Education Office,
Hsin Sheng Junior College of Medical Care and Management, Taiwan

Kuo-Wei Lin

Assistant Professor, Department of Physical Education Office,
National Central University, Taiwan

Xiao-Qing Wu

Lecturer, Department of Applied English, Ming Chuan University, Taiwan

Abstract:

In the age of technology, intelligent and innovative sports events present a brand new look, which has affected how many enterprises operate worldwide. Traditional sports events are upgraded to artificial intelligence. While broadcasting baseball, basketball, and other games, the automatic tracking system is used to perform real-time technical analysis, and the player's course can be analyzed on the spot. In the event broadcast part, the simulation technology, virtual and real integration are widely used, and the events could also be broadcasted live on the streaming audio-visual platform. Therefore, how to use big data analysis has become a key factor for the success of professional teams or sports marketing companies. This research explores the application classification and significance of big data analysis and artificial intelligence in the field of sports by analyzing relevant literature. Through this study, the significance and application of big data, the importance of big data analysis and artificial intelligence in sports industry, and the development trend of sports big data are preliminarily understood. It is also expected that the application and development trend of sports intelligence technology could help sports industry-related companies improve their competitiveness in terms of development strategies, thereby enhancing the visibility of Taiwan's sports industry in the world and making the research and development strength of Taiwan's sports enterprises visible to the world.

Keywords: Big data, artificial intelligence, sports industry

1. Moving toward the Era of Big Data

In recent years, science and technology have continued to advance. Using big data analysis and artificial intelligence could accurately predict anything that could be quantified. A lot of tedious work would be aided by artificial intelligence (AI) that could learn, understand, and decide how to react to new situations on its own, thinking logic and behavior patterns as humans as possible. Since the development of big data analysis, due to the rapid growth of data volume, the reduction of data storage and equipment costs, the improvement of software technology, and the maturity of the cloud environment, various software and hardware conditions are in place, nowadays, the big data is not only a data processing tool but also a corporate thinking and business model. This allows data analysis to evolve from the past 'understanding history' to 'predicting the future,' creating a brand-new business model.

Big data, which is the combination of structured, semi-structured, and unstructured data collected by organizations, is so large that it cannot be processed with traditional technology. Big data has become an essential part of the US\$64 billion database and analytics market. Among them, big data is defined by three characteristics:

- Capacity,
- Speed, and
- Diversity

These characteristics are usually called the 3V of big data. Thus, as the volume of global data grows, so does the market. Regardless of whether it is the public or private sector, the attention and discussion of big data have been in full swing (Jain & Bhatnagar, 2016). The business opportunities behind it have attracted the active investment of many software or technology companies. Furthermore, various manufacturers expect to take the lead in this emerging big data value chain and occupy a place.

After using these big data, data analysts of various companies could develop predictive models that allow us to look into the future, convert large amounts of data into feasible insights, improve decision-making and the organization of competitive advantage, and have the ability to organize and process large amounts of data, which is attributed to the maturity of the Internet of Things technology and the huge data database stored, and useful information can be obtained

from these data (Baro, Degoul, Beuscart, & Chazard, 2015; Noor et al., 2015; Romanillos, Austwick, Ettema, & Kruijff, 2016). Therefore, when the national government takes big data as an important means of governing the country, and enterprises regard big data as an essential tool to maintain competitiveness, it is obvious that the advent of the era of big data is strongly impacting and changing the scientific and technological life of human beings, with far-reaching influence (Hsu & Cheng, 2017). Today, the application of big data and artificial intelligence in the sports industry will bring significant development to the sports industry.

2. Big Data Changes the Sports Industry

In recent years, innovative technologies have been widely used in sports-related fields, such as big data event experience and analysis, intelligent sports products, sports media services, professional sports player training, business decision-making services, e-commerce, and so on. Professional teams in advanced countries in Europe and the United States use innovative technology to:

- Instantly grasp the overall performance of players,
- Make strategic plans, and
- Understand the experience of on-site fans

It is obvious that innovative technology has gradually changed the new outlook of the sports industry. Indeed, at major international sporting events such as basketball, baseball, football, and tennis, most professional sports organizations and teams have data analysts who are responsible for compiling statistics and developing indicators related to various aspects of athletic performance (Spaaij & Thiel, 2017).

Data science provides analysts with rigorous scientific techniques to organize raw data and transform it into mathematical and statistical models. With the digitalization and platformization of sports data, people have a better grasp of their physical conditions, and the rise of health awareness also leads to exercise motivation. The automation of management systems and the emergence of remote platforms have shortened the service waiting process, increased the convenience of use, and become the main reason for people to accept science and technology (Hung, Chang, & Chen, 2020). The reliability of big sports data is also very important because performance decisions are based on these data. Misinterpreting data would lead to excessive or insufficient performance capabilities, and subsequent harmful decisions might be made. An athlete may be weakened or falsely burdened with fatigue due to certain performance injuries (Katrina & Jennifer, 2017).

From the perspective of coaches' decision-making analysis, team performance, sports, and health, big data has had a substantial impact on the sports industry. Therefore, the data collected from wearable devices will play a vital role in the sports industry in the future by using AI artificial intelligence to conduct in-depth research on player action analysis so that coaches and players can clearly understand all sports performances on the court and provide players with important information needed to win matches. This will occupy a very important position in the sports industry in the future (Patel, Shah, & Shah, 2020).

Based on the above research, big data is completely changing the development of traditional sports. For the modern sports field, the most advanced data capture and analysis system is currently being used to improve the demand in the sports field. Therefore, the application development of big data is diversified; that is, through the analysis of sports big data, the collected big data is transformed into the analysis of sports technology, strategy, and tactics with application value.

3. Intelligent Technology Brings New Experience to Fans

In today's world, sports produce a wealth of statistical information about every player, team, game, and season. Traditional sports science believes that science belongs to experts, coaches, team managers, and analysts. However, sports organizations have recently realized that there is much science available in their data and have tried to utilize it by using data mining techniques (Keshtkar & Yamaghani, 2019). The main reason for the continuous innovation of human beings is technological breakthroughs. For example, the application of big data analysis will be able to understand the needs of users and provide sports products that are more suitable for users with new innovative materials. Major events will also increase the fairness of the game due to the use of a large number of sensors rather than relying on the personal judgment of the referee.

It is well-known that sports events have been competing with science and technology to keep fans' attention. A digital platform that combines sensor devices to collect data and store data is the first step in the application of technology. Let the audience become photographers to capture real-time images at the game site so that fans can participate more in live voting and opinion polling activities on the spot. Nowadays, there is a huge demand for wearable devices that can collect essential data and information during the execution of any activity in the sports field. The data and information are collected to obtain statistics or feedback to improve the user's sports skills (Pardo, Perez, & Uruñuela, 2019). In addition, the emotional response of fans could also be measured by AI facial recognition and cameras inside the stadium. It could help the team launch and manage its own app, thus narrowing the distance with the fans. Fans could use the app to browse team news, interact with players, buy tickets, watch videos, and perform other useful functions. These technologies have changed how we watch, play and train for sports. What used to be simple training is now a combination of smart IoT sensors, cameras, algorithms, and systems, and now it pushes the intelligence of technology to a new peak (Rajšp & Fister, 2020). Furthermore, fans would be able to experience a close-up view of the field through VR devices and enjoy a similar feeling to infield training by rotating 360 degrees. With the vigorous application of VR technology in sports, more and more fans could enjoy the service. With the development of big data and other technological devices, the game viewing

experience could provide different angles of the game screen, real-time data, personalized experience, and so on (Morgulev, Azar, & Lidor, 2018).

4. Smart Wearable Devices

Currently, there are thousands of wearable devices and smart clothing in the market that could help people monitor their own sports performance. However, in the sports field, more and more manufacturers invest in more precise and professional scientific and technological sports products to help athletes obtain more professional sports data and analyze sports conditions. Wearable devices, including pedometers, chest straps, sports watches, and smartphones with monitoring capabilities, allow coaches to collect data on a massive scale. Once the data has been collected, the next stage is big data analysis, which is a key step in sports training (Brzostowski & Szwach, 2018). The physical and psychological condition of the athletes before the game, the weather during the game, the surrounding environment of the sports venues, and the performance of the athletes on the field would all affect the games. In addition to the continuous rapid reaction of the athletes on the field, the timely adjustment of game strategies and tactics is also the key to victory. Therefore, the comprehensiveness and timeliness of data collection are particularly important. Whoever has more precise and accurate sports data would get a better chance of winning. The acceleration, endurance, speed, flexibility, and fatigue index of athletes are monitored through smart sensors. After collecting big data, it could be effectively used after calculation and analysis through the application system (Fister, Ljubič, Suganthan, Perc, & Fister, 2015).

Due to the lack of intelligence and data, traditional fitness equipment is difficult to collect, analyze and manage data. At present, smart somatosensory interactive devices with calculations, personal fitness data, and health resumes can be easily integrated. For coaches, the teaching quality could be improved through auxiliary training mode and motion detection: from experiential teaching to systematic data teaching, use of wearable devices, sensors, and IoT devices, and/or intelligent data analysis methods and/or tools to improve training performance and/or reduce workload while maintaining the same or better training performance. This means that the implementation ranges from simple tasks to the introduction of wearable devices in sports training courses, to intelligent data analysis of the courses, to more complex manual coaching implementations (Kamišalić, Fister, Turkanović & Karakatič, 2018). Sports monitoring equipment equipped with sensors mainly include:

- Running shoes,
- Insoles,
- Socks, and
- Other essential sports equipment

The 'intelligent' of these sports equipment generally provides feedback to users by collecting and analyzing data and realizes the functions of recording, sharing, and guidance.

5. The Use of Artificial Intelligence (AI) in Professional Teams

AI technology is developing rapidly in sports analysis and is widely regarded as one of the hottest topics in analysis technology (Sarlis & Tjortjis, 2020). Since the decision of a ball may become the key to the outcome in a ball game, the image-assisted decision system, which automatically determines whether the ball is in or out of bounds, is used to solve the controversy over artificial misjudgment (Ning, Yac, Wang, Benatallah, Dong, & Zhang, 2020). It has been adopted by professional sports events such as football, baseball, and basketball and has become the industry standard. Recently, deep learning has been applied in various fields. Take Major League Baseball (MLB), for example, which is currently the highest level of professional baseball in the world and one of the most popular international sports events. Many scholars have conducted research on predicting the outcome of MLB matches, but the accuracy of the prediction is very low. Therefore, it is important to use deep learning and machine learning methods to build models to predict the outcome of MLB matches and to investigate the differences in performance between the models (Huang & Li, 2021).

Basketball is also using statistical data analytics to improve player selection and game management to help win games. By collecting data, it is possible to analyze basketball players' shooting performance, moving speed, ball control rate, pass success rate, number of interceptions, physical condition, and other information, and provide the coaching team with the basis to think about the match's line-up arrangement and battle strategy, improve the speed and quality of decision-making. By collecting the data, we can analyze the basketball players' shooting performance, moving speed, ball control rate, passing success rate, number of interceptions, physical condition, and other information, providing the coaching team with the basis to think about the line-up arrangement and battle strategy to improve the speed and quality of decision-making. Scouts and coaches could use big data analysis methods to understand important player characteristics and ultimately measure and improve team performance (Zuccolotto, Manisera, & Sandri, 2018). In addition, with the development of the sports betting industry, analytical tools to predict the outcome of sports competitions have become critical (Fialho, Manhães, & Teixeira, 2019). Sports organizations and clubs are paying more and more attention to such research, which would ultimately help them have a competitive advantage over their competitors. The impact of these institutions incorporating these studies into their competitive approach has already had an impact both on and off the field (Thakkar & Shah, 2021). Therefore, for the enterprises operated by teams, the analysis of big data, formulating strategies, and improving the weaknesses could not only achieve the purpose of increasing the strength of football teams but also enhance the support of fans or the fun of watching matches, thus driving the development of the whole sports industry and boosting the business interests. The new sports technology would not only help players train but also bring considerable economic benefits to the box office and the operation of professional teams.

6. The Future Development Trend of Smart Technology in Sports Industry

With the rapid development of sports intelligence technology, regardless of large-scale professional events or personal sports fitness, the essence of sports is maintained to meet the needs of more precision, effectiveness, convenience, and fun enhancement. In the past, athletes' success was largely attributed to their own qualifications and efforts, as well as the cultivation of a good coaching team, information collection, and analysis. However, new technology now plays a key role. For example, before the game, technology could help coaches avoid sports injuries while helping players conduct customized training, maximize training results, improve players' overall sports performance, and formulate the most effective plan.

Smart technology has changed our way of life. Technology products have attracted sports enthusiasts, professional athletes, coaches, and other industry-related personnel. Adopting sports technology-related devices, platforms, and services has made many sports product development companies realize that artificial intelligence would affect sports marketing companies, sports operators, coaches, and so forth. As a result, the sports industry uses AI to gain a competitive advantage over competitors, with better sensors and algorithms to better predict the outcome of games and improve the competitiveness of the sports industry.

In summary, the rise of sports intelligence technology has enabled the sports industry to develop in the direction of big data, the Internet of Things, artificial intelligence, and other intelligent technologies, driving smart fitness equipment and wearable devices, among which platform services combining sports equipment and coach software applications grow fastest. It is believed that in the future, as the global sports trend continues to increase and the sports population expands, the benefits and business opportunities of sports smart technology development will obtain a new wave of business opportunities.

7. References

- i. Baro, E., Degoul, S., Beuscart, R., & Chazard, E. (2015). Toward a literature-driven definition of big data in healthcare. *BioMed Research International*, 1. doi:10.1155/2015/639021
- ii. Brzostowski, K., & Szwach, P. (2018). Data Fusion in Ubiquitous Sports Training: Computing.10, 1-14. doi: 10.1155/2018/8180296
- iii. Fialho, G., Manhães, A., & Teixeira, J.P. (2019). Predicting Sports Results with Artificial Intelligence—A Proposal Framework for Soccer Games. *Procedia Comput. Science*, 164, 131–136. doi: 10.1016/j.procs.2019.12.164
- iv. Fister, I. Jr., Ljubič, K., Suganthan, P.N., Perc, M., & Fister, I. (2015). Computational intelligence in sports: Challenges and opportunities within a new research domain. *Applied Mathematics and Computation*. 262. 178-186. doi: org /10.1016/j.amc.2015.04.004
- v. Hsu, P., & Cheng, S.T. (2017). Sport Big Data in the Era of Technology. *Journal of Physical Education National University of Tainan*,12,15–28.
- vi. Huang, M.L., & Li ,YZ. (2021). Use of Machine Learning and Deep Learning to Predict the Outcomes of Major League Baseball Matches. *Applied Sciences*, 11(10)4499. doi: 10.3390/app11104499
- vii. Hung, C.C., Chang C.J., & Chen, M.Y. (2020). Technology always comes from humanity: Application of intelligent technology in the fitness industry. *Physical Education Journal*, 53(2), 215–233. doi:10.6222/pej.202006_53(2).0006
- viii. Jain, A., & Bhatnagar, V. (2016). Olympics big data prognostications. *International Journal of Rough Sets and Data Analysis*, 3(4), 32–35. doi: org/10.4018/IJRSDA.2016100103
- ix. Kamišalić A, Fister I, Turkanović M, Karakatić S. (2018). Sensors and Functionalities of Non-Invasive Wrist-Wearable Devices: A Review. *Sensors*, 18(6), 1714. doi:10.3390/s18061714
- x. Katrina K., & Jennifer R. (2017). Tracking U.S. Professional Athletes: The Ethics of Biometric Technologies, *The American Journal of Bioethics*, 17,1, 45–60, doi: 10.1080/15265161.2016.1251633
- xi. Keshtkar Langaroudi, M., Yamaghani, M. (2019). Sports Result Prediction Based on Machine Learning and Computational Intelligence Approaches: A Survey. *Journal of Advances in Computer Engineering and Technology*, 5(1), 27–36.
- xii. Methodology and Application. *Wireless Communications and Mobile Morgulev, E., Azar, O.H., & Lidor, R. (2018). Sports analytics and the big-data era. International Journal of Data Science and Analysis*, 5, 213–222. doi: org/10.1007/s41060-017-0093-7
- xiii. Ning, X., Yac, L., Wang, X., Benatallah, B., Dong, M., & Zhang, S. (2020). Rating prediction via generative convolutional neural networks-based regression. *Pattern Recognit. Lett*, 132, 12–20. doi: 10.1016/j.patrec.2018.07.028
- xiv. Noor, A.M., Holmberg, L., Gillett, C., & Grigoriadis, A. (2015). Big data: the challenge for small research groups in the era of cancer genomics. *British Journal of Cancer*, 113(10), 1405–1412. doi:10.1038/bjc.2015.341
- xv. Pardo, L.B., Perez, D.B., & Uruñuela, C.O. (2019). Detection of Tennis Activities with Wearable Sensors. *Sensors*, 19(22), 5004. doi: 10.3390/s19225004
- xvi. Patel, D., Shah, D., & Shah, M. (2020). The Intertwine of Brain and Body: A Quantitative Analysis on How Big Data Influences the System of Sports. *Annals of Data Science*, 7, 1–16. doi: 10.1007/s40745-019-00239-y
- xvii. Rajšp A, & Fister I Jr. (2020). A Systematic Literature Review of Intelligent Data Analysis Methods for Smart Sport Training, *Applied Sciences*, 10(9), 3013. doi:10.3390/app10093013
- xviii. Romanillos, G., Austwick, M.Z., Ettema, D., & Kruijff, J.D. (2016). Big data and cycling. *Transport reviews*, 36(1), 114–133. doi:10.1080/01441647.2015.1084067
- xix. Sarlis, V., & Tjortjis, C. (2020). Sports analytics—Evaluation of basketball players and team performance.

- Information Systems, 93, 101562. doi:10.1016/j.is.2020.101562
- xx. Spaaij, R., & Thiel, A. (2017). Big data: critical questions for sport and society. *European Journal for Sport and Society*, 14 (1), 1-4. doi: org/10.1080/16138171.2017.1288374
- xxi. Thakkar, P., Shah, M. (2021). An Assessment of Football through the Lens of Data Science. *Annals of Data Science* doi: 10.1007/s40745-021-00323-2
- xxii. Zuccolotto P, Manisera M, & Sandri M. (2018). Big data analytics for modeling scoring probability in basketball: The effect of shooting under high-pressure conditions. *International Journal of Sports Science & Coaching*, 13(4)569-589. doi:10.1177/1747954117737492