NBA Big Data Analytics

What technologies do they currently use? How does it work?

All teams competing in the National Basketball Association (NBA) Championship officially use a system known as SportVU® by STATS LLC [1, 2]. SportVU® is an optical-tracking system that captures video and collects spatiotemporal data — in real time — at a data rate of 25 frames per second (see Figure 1). In essence, SportVU® is designed to track and follow the movements of every player and the ball, and also the referee, on a basketball court by virtue of automated identification and tracking mechanisms. As regards Euclidean geometry, SportVU® delivers the following statistical geometric data: *x*, *y* coordinates of the players (and the referee) in addition to the *x*, *y*, *z* coordinates of the ball. SportVU® employs advanced optical technology, video compression and statistical algorithms.
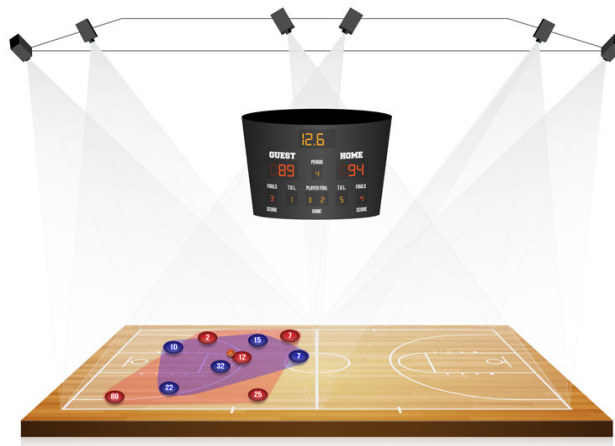

Figure 1: Graphical representation of STATS SportVU®, and its functionality, on a basketball court [3].

In terms of converting the captured and collected SportVU® Big Data into meaningful information (that NBA teams can leverage), data scientists are employed to provide comprehensive data analytics information. Once the SportVU® Big Data is collected, data scientists utilise a wide variety of techniques including AI-based machine learning, probability and statistics, data inference and modelling, data wrangling, linear regression and data visualisation. In such situations, data scientists use the following application software to engage in these tasks: R programming language, Python programming language, SQL database coding and MATLAB mathematical computing. The resulting information is then used by NBA team coaches to ascertain the following player performance metrics:

• Speed;
• Distance;
• Passing;
• Touches;
• Catch and Shoot;
• Pull-Up Shots;
• Possession;
• Dribbles;
• Drives;
• Defensive Impact;
• Rebounding Opportunities.

How long have they used SportVU®?

SportVU® has been installed, and is currently in operation, in every NBA arena; this has been the case since the 2013-2014 season. A trial of the technology was initiated by the NBA in 2011 and, by the 2012-13 season, 10 arenas had installed SportVU®. In terms of the history of SportVU®, the raw propriety technology was invented for utilisation in military operations (missile tracking in particular). The proprietary technology was invented by two Israeli missile tracking and advanced optical recognition scientists — Gal Oz and Miky Tamir — in 2005. The system was eventually adopted by STATS and rebranded as SportVU®.

Is SportVU® linked with physiological data of the player?

SportVU® does not possess the capacity to capture the physiological data of a basketball player. As previously mentioned, the primary functionality of SportVU® is to supply spatiotemporal (video) and statistical data; it operates in real time at 25 frames per second. The Big Data produced by SportVU® is essentially meaningless until it is harvested, compartmentalised and converted into meaningful information by data scientists. As asserted by Edwards et al. (2018) [4], employing technology to capture physiological data, such as fatigue markers, for example, is a challenging situation. This is primarily due to the fact that very little academic/professional research has been conducted in this area. Furthermore, monitoring an individual's core medical data is conducive to legal and privacy implications.

What current technologies might be adopted in the next 1-5 years?

Global Positioning System (GPS)-based wearable technology appears to be the leading contender for NBA sanctioned adoption. Non-specific wearable technologies from various corporations are presently utilised on an ad-hoc basis. For example, the Kinexon® wearable sensor, which is claimed to be the most used wearable technology in the NBA [5], measures the geospatial location of a player based on GPS technology (used by players in training sessions). That is, in conjunction with the proprietary Kinexon® data analytics software, the Kinexon® wearable sensor is designed to track the location of a player for the purpose of performing player performance data analytics (as is the case with SportVU®). In terms of functionality, by measuring the Cartesian coordinates x, y, z of players in real time, with the origin at the earth's centre, GPS-based devices such as the Kinexon® wearable sensor can quantify the latitude, longitude and altitude of a player with great precision. Because SportVU® is an optical-based technology, GPS-based wearable devices have the potential to provide a much greater level of precision in terms of ascertaining the real time location of a player. However, GPS devices only have the capacity to produce certain types of Big Data (e.g., recording the latitude, longitude and altitude of a player in numerical form). SportVU®, on the other hand, includes the major advantage of video-based technology, which allows for the spatiotemporal recording of real time video data at 25 frames per second. For this reason, it is likely that GPS-based wearable technologies will be employed to supplement SportVU® (rather than replace it entirely).

PEST Analysis: NBA and NBA Teams

- **Political**

The NBA is presently China's most popular sports league. Therefore, in terms of match viewing figures and merchandise purchases, China will probably constitute a significant portion of the revenue for the NBA and NBA teams. Unfortunately, the current trade war between the United States and China could prove to be deleterious for the NBA. For example, if the Chinese government decides to take drastic action, such as denying Chinese citizens the right to access popular American websites (including NBA.com), this could have a sizable negative impact on cash flows for the NBA and its constituent teams.

- **Economic**

As is the case with all for-profit corporations, economic growth is, by far and away, the primary concern for all NBA teams and the NBA itself. The National Basketball Association, Inc., is a profit-driven business corporation [6], so too are all of the teams competing in the NBA Championship [7]. The primary economic drivers include pressure from fans — in relation to the all-important ticket sale revenue and cash flows — in addition to external economic factors including global TV and sponsorship deals. The adoption of performance analytics technology has the potential to offer a competitive advantage in terms of driving sustainable economic growth.

- **Social**

According to some sources, certain NBA fans in the United States are losing interest in NBA basketball because of its perceived lack of excitement. In other words, it is interpreted to be losing some of its entertainment value because of its perceived predictability. For example, some believe that the extensive utilisation of player performance analytics-based tactics may have made the game appear somewhat mechanical and dispassionate at times. This needs to be taken into account by the NBA and NBA teams.

- **Technological**

In terms of advanced Big Data technology adoption, this has proved to be a commercial success for the NBA and NBA teams. However, NBA teams must strategically circumvent the issue pertaining to the perceived lack of excitement by some fans during NBA Championship games; e.g., by injecting innovation into tactics or other forms of innovative play. Undoubtedly, the employment of performance analytics technology significantly improves the performance of top teams in terms of results, tactics and the athleticism of players. As such, these technology-facilitated improvements may give rise to a higher probability of landing lucrative TV deals, sponsorship deals and merchandising sales in addition to stimulating an increased interest in NBA teams and the NBA brand on a global scale. Moreover, by harnessing the power of social media (Twitter in particular), the NBA and NBA teams can reach a global audience in real time. As an example, the NBA Twitter page has amassed approximately 28 million followers; this considerable reach is of paramount importance to NBA business operations on a global scale.

How much is innovation driven by the NBA rather than the teams?

With regard to Big Data analytics, neither the NBA, nor the teams, drive technological innovation. The innovation is typically research-orientated in nature and is thus driven by researchers in world-class academic institutions — including Harvard University, MIT and University of Cambridge — and global IT corporations including Google, Microsoft and IBM. The NBA simply drives commercial demand for such innovative technologies. To repeat, the SportVU® system by STATS was originally used for military operations; the Israeli missile tracking and advanced optical recognition scientists, Gal Oz and Miky Tamir, gave rise to the innovation of what is now called SportVU®.

As well as being a for-profit business corporation, the NBA is the governing body of professional basketball in the United States. Therefore, any team that competes in the NBA Championship, for example, must abide by the governing rules decreed by the NBA. For example, state-of-the-art wearable technology is not allowed to be used during an official NBA match, nor can data be extracted during training sessions for use during player contract negotiations. With this in mind, even if teams wished to drive technological innovation, they would be unable to do so. This is because the NBA holds the power over all aspects of permitted technology and related decision-making.

What is the typical supply chain for technology adoption into the teams?

Specific information on NBA-sanctioned technology adoption into each team, including SportVU®, does not exist in the public domain. Because the NBA is a business corporation (i.e., National Basketball Association, Inc. [6]), it is not obligated to publicly share specific details concerning its supply chain and global procurement procedures. However, on the NBA.com website, it provides certain details concerning the NBA's Supplier Diversity and Inclusion Program. That is, the NBA has created an initiative known as NBA Green [7]. NBA Green has formed a partnership with the Natural Resources Defense Council (NRDC) of the United States. It is a program designed to encouragement environmentally friendly procurement; this includes both the NBA and its constituent teams. In the Appliances and Electronics section in [8], it states the following (verbatim):

"*The NBA is seeking to reduce our consumption of energy by increasing efficiency. As it relates to appliance and electronic product specifications, we support:*

Electronic products certified by EPA's Energy Star program;

Electronic products that have other energy saving features such as programmability and power-save functions;

Electronic products that use as little energy as possible while in "off" mode."

The NBA employs a Chief Procurement Officer (CPO), named Joseph R Postiglione, who is also the Vice President of the NBA [9]. Mr. Postiglione is, among other things, responsible for supply chain and procurement strategy on a global scale; this includes procurement policy creation, process oversight, vendor performance management and data analysis. In an article written by Mr. Postiglione, entitled: "Top Performing Sourcing Functions", he asserts that there are seven important areas that should be adhered to, which are as follows (verbatim) [10]:

• Spend Data Analytics and Data Mining;
• Market Research and Benchmarking;
• Internal Customer Satisfaction and Service;
• Sourcing Strategy and Contract Negotiation;
• Contract Compliance;
• Supplier Relationship and Performance Management;
• Tactical P2P Execution.

In essence, he asserts that, by providing a robust, centralised and organised procurement framework within which to operate, supply chain can be conducted in a rigorous and highly efficient manner. This pertains to the NBA, the constituent NBA teams and also the associated external stakeholders with whom the NBA conducts business.

Do NBA teams interact regarding adoption? Is it NBA or team-driven?

As previously mentioned, the NBA is the governing body of professional basketball in the United States. Therefore, technology adoption is entirely NBA-driven. The constituent teams of the NBA league must comply with all of the rules and regulations decreed by the NBA; this includes the official adoption of new technologies (including SportVU®). Senior executives of NBA teams and, indeed, players of NBA teams might discuss potential technology adoption in the future. However, this would typically be considered as unofficial and casual discourse (as opposed to official business-orientated discussions).

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