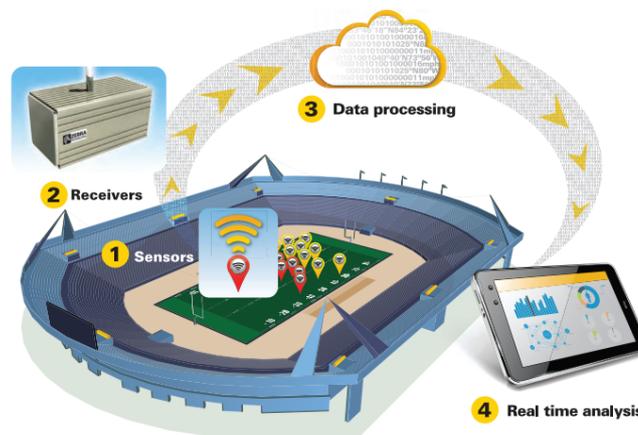


# NFL Big Data Analytics

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

Zebra Technologies Corporation, with its Zebra MotionWorks™ technology [1], is the real time and on-field tracking partner of the National Football League (NFL) [2]. Zebra MotionWorks™ is a Radio Frequency Identification (RFID) system that is designed to capture motion data of a player and the ball. Two RFID sensors are inserted into the shoulder pads of a football player; in addition, a tag sensor is attached to the football (see Figure 1). It is important to note that MotionWorks™, as with all RFID devices, is not application specific to the NFL; that is, it can be used in a wide variety of industries for the motion tracking of objects. To reiterate, in terms of its application to the NFL for player performance analytics, it is utilised to track the motion of a player and the football. Coaches can harness the acquired data to, for example, analyse grouping and formation, running patterns, player and ball speed, pass coverage, separation distances in addition to assessing quarterback pressure. The associated application software of MotionWorks™ operates by indentifying objects in the context of a 3D Euclidean space.



**Figure 1:** Graphical representation of Zebra MotionWorks™, and its workings, on a football pitch.

As shown in Figure 1, MotionWorks™ system works by virtue of the RFID sensors in the players' shoulder pads and in the ball. By harnessing the nature of light waves (not to be confused with “visible light” radiation) in the lower frequency range of the electromagnetic spectrum, radio wave receivers capture the data in the form of photons/waves. Note that, according to wave-particle duality in quantum mechanics, photons naturally behave as both a wave and a particle [3]. This motion Big Data is then transmitted for data processing and, consequently, it is curated into meaningful information in real time. Human users, such as NFL coaches, can then analyse the aforementioned motion information via Zebra's proprietary application software; this is accessible on computer hardware including “smart” devices (tablets and smartphones) and PCs/laptops. In addition to the aforementioned functionality of the MotionWorks™ system, an online service known as NFL Next Gen Stats [4], which utilises the processed information from MotionWorks™, is accessible to all NFL teams and the general public.

## How long have they used MotionWorks™?

The partnership between Zebra Technologies and the NFL commenced in the 2014/15 season [5]; a five year deal was established between Zebra Technologies and the NFL, which has since been extended. Initially, in 2014, the NFL employed MotionWorks™ in 17 out of the 32 teams' stadiums in the NFL. As of 2019 and due to the success of the initial implementation, MotionWorks™ is now utilised ubiquitously in the entire NFL league. Furthermore, Zebra Technologies formed an official partnership with Wilson Sporting Goods in relation to applying the MotionWorks™ RFID tags to footballs.



Figure 2: The PREVENT™ smart mouthguard system by Prevent Biometrics [8].

## Is MotionWorks™ linked with physiological data of the player?

As the governing body of football in the United States, the NFL has not yet sanctioned the adoption of state-of-the-art technology that is able to monitor the physiological data of a player. Certain technologies are in the pipeline, however; this will be covered in the next section. In terms of Zebra MotionWorks™, this system is purely a vector-based motion tracking device [6]. That is, it provides Big Data in relation to the position of objects (i.e., football players and footballs) in a Euclidean space. As per the official MotionWorks™ documentation [7], the data capture hardware includes a Dart Ultra-Wideband (UWB) active RFID system that provides real time location data (3D, 2D and/or 1D) with an accuracy of approximately 30cm.

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

The most anticipated technology that has the potential to be officially adopted by the NFL is a wearable device for detecting potential concussion. Since concussion is an important medical issue (and due to the extremely physical and high impact nature of NFL football), a number of business corporations are competing for a potential partnership with the NFL. The leading contender appears to be Prevent Biometrics, Inc. Prevent Biometrics has developed a product named PREVENT™ [9] (see Figure 2). As is evident in Figure 2, PREVENT™ is a smart mouthguard device. In terms of the functionality of PREVENT™, the authors of the Prevent Biometrics article in [9] state the following (verbatim):

*“It works through four accelerometers on the mouth guard that triangulate to a point in space, the centre of gravity of the head. And you’re monitoring things continuously in real time between the location around the arch of the front teeth to the centre of the head. That point in space is what we’re measuring: it involves linear acceleration, angular acceleration, and, because it has six degrees of freedom, we’re able to accurately detect location and direction of the impact, as well as the number of impacts. And that number metric is crucial, because it’s believed to contribute to the cousin of concussions, Chronic Traumatic Encephalopathy (CTE).”*

## PEST Analysis: NFL and NFL Teams

- **Political**

The NFL and its constituent teams became heavily intertwined with national politics during the period 2016-2018 [10]. Certain NFL players refused to participate in the traditional NFL national anthem renditions for the following political reasons: 1) protestations against Donald Trump as president of the United States, 2) protestations against perceived social injustice, and 3) protestations against perceived racial discrimination. These events dominated certain aspects of USA national mass media for several weeks. From the standpoint of many citizens of the USA, NFL players should not have involved themselves with political issues. This is because fans pay their hard-earned money to be entertained by watching NFL teams play football; that is to say, political issues should not be a cause for concern.

- **Economic**

National Football League, Inc., and its constituent teams, are for-profit business corporations [11, 12]. The extraneous politically-motivated behaviours in which certain players engaged during NFL national anthem sessions had a significantly negative economic impact on the NFL and its constituent teams. For example, certain NFL fans boycotted NFL-related events because of it (both TV-related events and stadium events), which resulted in decreased ticket sales in addition to decreased merchandise sales. Therefore, these politically-motivated actions proved to be relatively disastrous for the reputation of the NFL brand, NFL teams and certain NFL players. In essence, it was not, in any way, shape or form, good for business. As of 2019, the NFL has decreed strict regulations to ensure that such behaviours are not repeated.

- **Social**

In the age of 24-hour digital mass media and social media applications including Twitter, the perceptual fallout resulting from the politically-motivated actions undertaken by certain players — most notably Colin Kaepernick — persists today. For instance, celebrities including Rihanna and Amy Schumer boycotted NFL Super Bowl LIII (2019) [13]. Rihanna is the fourth most followed person on Twitter, with 91.1 million followers [14]; as such, the social snowball effect is likely to be considerable. That is, Rihanna probably has a vast influence over a relatively large number of her fans; some of these fans may also be loyal NFL fans. Consequently, if Rihanna boycotts NFL Super Bowl LIII, there is a chance that some of her fans may also decide to boycott it. This is just one example that the NFL, and its constituent teams, must take into consideration whilst engaging in external factor analysis related to social perception.

- **Technological**

The official integration of Zebra MotionWorks™ into the NFL has two distinct advantages. They are as follows: 1) the information derived from the motion Big Data is very useful for real time player performance analytics and, 2) it provides clever technological engagement with NFL fans, both in real time (in stadiums and on TV) and also with the NFL Next Gen Stats online database [4]. Because the NFL and its constituent teams are for-profit business corporations, the official implementation of these player performance systems form part of an economically driven strategy, which is to increase net income. By improving the overall quality of a player, tactics and team performance, this increases the likelihood of further engaging fans and sponsors, thereby generating improved cash flows from ticket sales, merchandise sales, sponsorship deals and TV agreements. Also, as with all global sports brands, brand awareness is extremely important to the NFL; therefore, carefully coordinated social media engagement (e.g., Twitter) is extremely important.

## **How much is innovation driven by the NFL rather than the teams?**

In terms of the adoption of new technologies, customers/clients typically do not drive innovation. In the context of the adoption of Zebra MotionWorks™, the NFL and NFL teams are essentially the customers of Zebra Technologies. Therefore, neither the NFL, nor the NFL teams, drive the actual innovation; innovations are typically driven by research scientists. In the example of Zebra MotionWorks™, this system is not particularly innovative. RFID has its roots in the USSR; a Russian physicist, known as Leon Theremin, invented an RFID-related device in 1945-46 for use in military operations. Due to its indisputable usefulness, RFID has achieved wide global adoption in a vast variety of industries, which includes sport. With application to player performance analytics, Zebra Technologies developed the proprietary software used to work in conjunction with the RFID technology. The code is closed source (i.e., not open source); therefore, the source code cannot be analysed to ascertain its level of novelty.



Figure 3: The Kraljic Matrix for supply chain management, which is utilised by the NFL [15].

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

The NFL is considered by many to be a masterful corporation in terms of its supply chain efficiency; it is, undoubtedly, a very strong component of the NFL. The NFL appears to follow the Kraljic Model [15] for all aspects of supply chain management, which includes the procurement of technology and players. Kraljic's model stipulates that there exists a fundamental relationship between the suppliers of products, profit impact and supply risk (see Figure 3). That is, a supplier should be conceptually entangled with the probability of risk (e.g., an unexpected disruption to proceedings) and the likelihood of attaining healthy profit margins (i.e., the degree to which the purchased item contributes to net income). The NFL even holds an annual event pertaining to the supply chain of players, which is known as NFL Draft [16]; this Big Data-driven supply chain system essentially grades players based on analytics derived from in-play information.

It is also noteworthy to mention NFL's astute implementation of the Zebra MotionWorks™ system. Not only is it utilised extensively by coaches (for analysing player performance information), it is also designed to intensively engage fans with the action on the field. That is, fans can interact, in real time, with information provided by Zebra MotionWorks™; this is possible via smart and computing devices including smartphones, tablets, PCs and laptops. This is another example of NFL's mastery in supply chain management; that is, they have adopted and implemented technology with maximum impact (in accordance with Kraljic's model).

## Do NFL teams interact regarding adoption? Is it NFL or team driven?

NFL team members might casually discuss the potential of future technology adoption; however, this would be considered as an "of-the-record" conversation. Very similar in structure to the NBA, the NFL is the governing body of professional football in the United States. For this reason, the procurement and adoption of new technologies is governed, and driven, by the NFL. Therefore, all 32 teams in the NFL must adhere to all policies, guidelines and procedures related to NFL technology implementation.

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