Big Data in the Decision-Making Processes of Football Teams

Theoretical Framework, Applications and Reach

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Summary

This article explores the impact of the introduction of Big Data into the internal processes and decision making of football[1] teams, evaluating its relevance in business administration and strategy, as well as in the technical management of players and teams.

First, we propose a conceptual framework from which the applications and consequences of using these technologies will be analyzed, valuing their extraordinary potential to disrupt the entire sports industry. The primary focus revolves around the influence of Big Data to evolve the whole strategic decision-making process.

Second, we wish to promote reflection on the profound technological revolution that is taking place in the sports industry, evaluating its current and future reach through the analysis of two cases that are relevant to the football ecosystem.

Among the main conclusions of this exploratory conceptual study, we could mention: the boom of data analysis in sports, going beyond the traditional correlations and causal relations extracted from random statistics; the development of new technological devices that give rise to new and meaningful sources of information, being able to process, interpret, present, and share these data in real time; and the more and more constant implementation of scientific methods in the decision-making process, with the former being directly linked to the achievement of satisfactory results.

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[1] The term "football," which is used throughout this document, refers to the sport of association football, commonly known as "soccer" in the United States.

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Introduction

In the last few decades, data have become an essential part of business activities, creating a strong disruption that has led to a new approach to managerial decision making. This has taken place due to the mass adoption of new technologies, especially the innovation brought about by the arrival of mobile internet access, which has led to an exponential increase in the creation and storage of information.

This global contribution to the mass generation of information can be perceived across different industries around the world, with companies nowadays storing large amounts of transactional data, analyzing and interpreting key information about their employees, clients, providers and suppliers, competitors or internal processes in order to create and capture value for individuals, organizations, and communities. The smart government of this tremendous wealth of data is what is known as Big Data.

To be able to understand the magnitude and reach of Big Data, it is worth noting that, according to IBM, 90% of the data in the world today has been created in the last two years.[2] This situation can be attributed to the generalization of technological resources, which have been silently gathering data from cellular terminals, car sensors, emails and websites.

In this article, we will delve deeper into the transformative impact that has been caused by the obtention and interpretation of these data in business administration. We have chosen the football industry as our object of analysis precisely because of its extensive ability to offer a plethora of indicators that allow us to express, how the optimal combination and scrutiny of information can trigger considerable improvement in the economic and technical performance of its protagonists.

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[2]   www.ibm.com/blogs/insights-on-business/consumer-products/2-5-quintillion-bytes-of-data-created-every-day-how-does-cpg-retail-manage-it/

Theoretical Framework

Conceptualization of Big Data

The concept of "Big Data," popularized by Francis Diebold in 2003, is used to refer to large amounts of data from different sources (with an increasing volume, variety, and velocity), along with the necessary techniques to be able to collect, store, manage, and analyze them (Beyer & Laney, 2012). Big Data can be generated from an increasing diversity of sources, such as internet clicks, digital commercial transactions, emails, instant messaging, user-generated written or audiovisual content, social networks, data coming from smart sensors and any other device that is connected to the internet, ranging from wearables to virtual reality and augmented reality terminals.

To give you a rough idea, nowadays, each participant in a Formula 1 race generates 20 gigabytes of data coming from the 150 sensors placed in the car, which help us to analyze the technical performance of each component, as well as to measure the driver's reactions, the delays at each pit stop, and the communication between the team's management and the driver regarding the general performance of everyone involved in the competition (Munford, 2014).

There are five characteristics that set Big Data apart from other processes that were used to gather information before. These attributes can be summarized in the 5 Vs, which are: 1) Veracity (the reliability and relevance of the data); 2) Velocity (the speed with which the data is collected or generated); 3) Value (the usefulness of the data); 4) Variety (the types, contents, and formats); and 5) Volume (the amount of data) (Jiang, 2015).

For an organization that is facing the challenge of how to manage its information, Big Data is the solution to put modern, professional, and efficient management into effect. Consequently, any company that introduces this technology will be facing three fundamental challenges: storage, processing, and access to the data (Martin; López-de-Ipiña; Alzua-Sorzabal; Lamsfus; Torres-Manzanera, 2013).

This challenge has brought about the advent of a number of firms, institutions, and individuals that have taken up the task of integrating knowledge from different academic disciplines, such as statistics, computer science, applied mathematics or economics, leading to the emergence of new data-management techniques, such as A/B testing, cluster analysis, data consolidation and integration, data mining, genetic algorithms, automated learning, cognitive intelligence, machine learning, natural language processing, neural networks, signal processing, spatial analysis or time-series analysis or simulation (Instituto Global McKinsey, 2011).

Their practical application to the internal processes of a traditional business can be perceived in activities geared toward generating savings for and increasing the added value of a business, such as customer portfolio optimization, point of sale inventory optimization, internet trend analysis for the portfolio management of goods and services, publicity personalization, analysis of moments of truth, and many other commercial actions. Without a doubt, Big Data has an overriding reach in the improvement of the customer experience, revitalizing the commercial offer, transforming the commercial channels, modernizing the client communication network, and increasing the efficacy and efficiency of processes and operations.

The aforementioned innovations have given rise to an irreversible revolution in top business management, resulting in the profound transformation of the decision-making method (McAffee, 2012). This permeates the managerial process with a new scientific dimension, which is strongly analytical and full of indicators. This allows us to not only identify correlations and establish causality relations, but also to forge a convergence of information through independent sources that offer useful and profitable conclusions in a shorter period of time.

Big Data in Football: The New Game

Sports entities are no strangers to the progressive digitalization that is being experienced by business administration, as they are a group of organizations that stand out precisely because they have a large amount of data at their disposal and are fully aware of the value of extracting relevant information that constitutes a differential competitive and educational value.

In the world of football, data analysis technology was successfully used by the Mexican football team in 2014 during its qualification match for the Brazil World Cup against New Zealand and later by Germany in the friendlies before the competition and during the competition. In Mexico, thousands of statistics were analyzed to design the line-up and the tactics to be applied during the match. In Germany, they resorted to placing sensors on the players and using cameras during training sessions to measure and to enhance the athletes' performance. It is especially relevant to point out that it was the interpretation of Big Data that facilitated and determined the strategic decisions adopted by the technical staff of both teams. That same year, software company SAP signed an agreement with FC Bayern Munich in order to improve the physical performance of its players as well as the health of its entire staff.

Through the development of new applications, the firm analyzed the real-time footage of matches as well as different indicators, such as the percentage of successful passes, the power of the shots, the speed, and the distance traveled by each player to generate real-time reports and to simplify the technical work that needed to be done when making decisions. This example shows not only the influence of Big Data on strategic decisions, but the fact that these decisions can be generated immediately, offering instant suggestions.

Nevertheless, data analysis in sports had been popularized by the publication of *Moneyball: The Art of Winning an Unfair Game,* written by Michael Lewis, in 2003. The book narrated the success of Billy Beane, trainer of the Oakland Athletics baseball team, who got his team to unexpectedly improve its performance during the 2002 season by analyzing and interpreting statistics. Years later, this same logic would be implemented and improved by other teams, such as the Boston Red Sox and the Houston Astros, also obtaining excellent results.

Exhibit 1 shows the timeline of Big Data's most prominent milestones in sports.

With the emergence of the *wearable* technology, which refers to the set of electronic devices that are attached to our bodies through objects such as clothes, shoes, glasses or watches, data gathering has increased exponentially. The vests worn by some football teams during training sessions and matches are a prime example of this, as they use GPS sensors, accelerometers, gyroscopes, cardiometers, oximeters and shock sensors, allowing us to:

- **Quantify muscle fatigue and wasting**, helping to prevent muscle injuries.

- **Calculate variables** such as the speed or distance traveled to quantify the player's performance.

- **Design or map out areas**, like a heat map of the areas a player goes through to establish precise movement patterns.

- **Evaluate the physical strain** suffered by the body through shock to prevent joint injuries.

Yet, in sports, it is not data themselves that matter, but the value they can have once they are processed. For example, nowadays, 77.7 million data entries are gathered and analyzed in a one-hour training session, so the real key is separating what is relevant from what is irrelevant.

Exploring the Industry of Big Data

Over the past few years, Big Data has become an extraordinarily relevant market that has enjoyed tremendous growth, with world-renowned companies standing out in this arena. Additionally, hiring partnerships that specialize in Big Data has become key to the success of large organizations. Companies like Microsoft, Oracle or IBM in the United States have adopted the role of transnational partners and, over the next few years, they will fight to maintain their privileged position, competing against not only hi-tech giants like Google, Amazon, Apple, and Facebook, but also against other regional leaders with a global vocation, such as Telefónica-Movistar, Orange or SAP in Europe, and Stefanini, PSL Corp, Alestra, Huawei or ChinaSoft in Latin America and Asia.

The use of Big Data in the consultancy and added-value services sector is extremely relevant, and it has become a key differentiator when diagnosing and offering proposals. It has been used by large knowledge management businesses, such as McKinsey, BCG, KPMG and Deloitte, and by other competitors in the sector that are aware of the significance of effective information management, such as Capgemini and Indra in the information technology arena, WPP and Havas Media in marketing and public relations, Roche and AstraZeneca in the pharmaceutical industry, UPS and FedEx in logistics, or Grant Thornton and Heza Consultoría Integral in accountancy and finance.

The global revenue generated by Big Data and business analytics reached $189.1 billion dollars in 2019, representing 36% of the revenues of the overall software development market as of 2018, with IBM being the world's largest vendor of hardware, software, and Big Data services, grossing 2.66 billion dollars for this concept (Liu, 2019). An analysis conducted by firm Frost & Sullivan determined that the Big Data and Analytics (BDA) market in Latin America generated 2.9 billion in revenues in 2019. Brazil is currently at the forefront in LATAM, as it has 46.7% of total sales. It is followed by Mexico with 26.7%; Colombia with 7.9%; Chile with 6.9%; Argentina with 5.6%; and Peru with 2.4%. It is expected to reach 8.5 billion by 2023, at a compound annual growth rate of 19.2 percent.

In 2018, according to IDC, the wearable technology market grew by 27.9 million units, which is 5.5% more than the previous year. The business had an 8.3% interannual growth rate, reaching 4.8 billion dollars. The emerging markets, including Asia-Pacific (excluding Japan), Central and Eastern Europe, the Middle East and Africa, and Latin America grew by 14%. In this case, basic wristbands are still in great demand (due to their low price), and smartwatches have also gained traction. IDTechEx Research forecasts that the wearable device market will reach more than $150 billion dollars per year by 2027.

The following table contains a list of pioneering companies in data analytics and their solutions for the Football industry.

Table 1. Pioneering Companies and Solutions for Data Analysis in the Football Industry

Company (Country of Origin)	Product/Service Description
SAP (Germany)	Cloud solution powered by the platform SAP HANA, focused on sports practices (team management, training planning, performance analysis).
Mediacoach (Spain)	Advanced professional video motion analysis tool, integrated with physical and tactical data.
Match Analysis (United States)	Developer of programs that analyze football videos and technical statistics.
Wyscout (Italy)	Platform that allows people to see matches taking place all around the world from a computer, a tablet or a mobile phone.
GolStats (Mexico)	Technology development, and content and information supply linked to videos for professional football teams and the media (20 million data per match with virtual reality technology).
Opta Sports (United Kingdom)	English-based Sports analytics company providing data for 30 sports in 70 countries.
Stats (United States)	Provider of solutions for fan engagement and team performance using artificial intelligence.
Catapult Sports (Australia)	Provider of sports performance analytics to support players, teams, and trainers.
Real Track Systems (Spain)	A physical activity monitoring system using Wimu, a WiFi data collection device, and SPRO, a simple and flexible application.
Second Spectrum (United States)	A company focused on the development of machine learning, computer vision, and augmented reality technology solutions for the sports industry.

Source: Designed by the authors

The Impact of Big Data on Decision-Making Processes

Nowadays, we can identify six main areas in which Big Data is transforming and facilitating decision making in the world of football:

1) *Technical Decisions*
   - The technical team can collect athletes' real-time data using portable sensor technologies.
   - The analytical tool provides real-time data about the athletes, such as their speed, hydration, fatigue, pain or heart rate.
   - The data can be stored and checked by the technical team, the managers, and the medical staff using mobile devices.
   - The technical team can identify tactical mistakes made by the athlete and the team in order to train them to overcome these errors.

2) *Predictive Analytics*
   - It analyzes the effectiveness of the tactics applied in real time.
   - It provides different reports from a myriad of data sources: biometrics, referee, technical team or new player performance.
   - It anticipates the athletes' strength, highlighting safety issues and reducing the risk of injury.
   - The tool identifies the right players for the match according to their characteristics and attributes as well as their rivals'.
   - Predictive analysis of the team's players and the rival team's players.

3) *Event Marketing*
   - It allows them to predict which advertisement, promotion or direct communication activity will attract more followers and fans, which allows them to increase the precision of marketing plans and optimize revenues during the match.
   - The pricing model can be established through segment discrimination, offering the best return on investment to advertisers, as analytics tools have measurement techniques for each player and team.
   - The source of analytics differentiates loyal followers from new followers in order to develop personalized campaigns.

4) *Businesses and Public Services around the Venue of the Sports Event*
   - The Internet of Things (IoT) allows us to get data about the spectators attending a sports event, from where they connect to the Internet to the matches they will attend or where they will access the stadium through, providing a geolocation system that allows them to market goods and services to the neighboring businesses.

- Depending on the number of tickets sold, the city can prepare to serve its audience, strengthening the client's experience by substantially improving public services and access routes.

5) *Resource Efficiency*
- Stadiums can set appropriate lighting and temperature to better focus their use of water and people.
- If they have smart facilities, they can control the performance of all the resources with a greater level of precision.

6) *Weather Prediction*
- The delay or cancellation of sports events can be prevented by implementing better safety devices, preparing the stadium and redirecting the necessary resources.

Table 2 illustrates some of the football teams that have shown greater interest in the use of Big Data.

Table 2. Football with greater interest in Big Data

Team	Statistics	Wearables	System	Motivation
AC Milan	X	X	Milan LAB (proprietary)	Petition from the trainer, Arrigo Sacchi, devoted to preventing injuries; it is maintained and perfected.
Bayern Munich	X	X	SAP	Geared toward improving the institution's athletic performance.
FC Barcelona	X	X	COR (proprietary)	Proprietary system to preserve the club's football style and corporate culture.
Manchester City	X	X	SAP	It seeks the integration of the City Football Group (CFG), which includes Manchester City, New York City, Melbourne City, and Yokohama Marinos.
Real Madrid	X	X	Microsoft Dynamics	Petition from the trainer, Rafa Benítez. Agreement not only focused on sports, but also on the simplification of its administrative management.

Source: Designed by the authors

Performance Tracking Systems using Wearables

Player tracking devices or systems, consisting of technology with cameras and techno accessories, are used to control and improve players' individual and team performance. These systems mainly track the position of the players and the ball, although they can also be used together with other micro electromechanical instruments (accelerometers, gyroscopes, etc.) and pulsometers, in addition to other devices that measure load or physiological parameters.

In the current market, there are three kinds of devices used to provide physical tracking: 1) cameras with optical sensors, 2) local positioning, and 3) GPS/GNSS systems. These devices can be combined with micro electromechanical instruments (accelerometers, gyroscopes, compasses, etc.) to offer data about the inertial loads as well as other medical information. **Table 3** provides an analysis of the advantages and disadvantages of the different types of devices used to provide physical tracking.

Table 3. Classification of Physical Tracking Devices

Type of Device	Advantages	Disadvantages
Cameras with an Optical Sensor	• Non-invasive for the player • Commonly used in the football market • High sampling rates; ball tracking is available	• Limited number of measurements • Tracking blockages require manual corrections • Installation time
Local Positioning System (LPS)	• High number of measurements available • Precision of the data collected in real time • Ultra-broadband technology that reduces transmission interference	• Fixed installation • Installation costs • Installation time
GPS/GNSS System	• It does not require an operator • It offers the possibility of having multiple metrics • Quick and simple installation	• It requires a satellite signal or connection in the stadium or the place where the sports event will take place • The data obtained are not always clear • Their size makes them difficult to place in players' bodies

Source: Designed by the authors

Methodology

The research focuses on the revision and updating of the context in which Big Data is being introduced in the sports industry. It will analyze the marketing activities in which these phenomena have successfully come together to improve economic and sports results. With this aim, we will analyze the cases of FC Barcelona and the Aspire Academy in Qatar as examples of a determined vision to underpin their success with information management.

The methodology used in this paper is of a descriptive-qualitative nature. Through the qualitative and conceptual approach, we aim to study reality in its natural context, extracting and interpreting phenomena in accordance with its protagonists, while, with the descriptive method, the research is geared toward the systematic observation of the industry, categorizing the information so that it can be used and replicated from academic and informative sources, evaluating current case studies. By the same token, we also include interviews with some of the players that are most involved in the business disruption proposed by Big Data in order to paint a larger picture.

Case Studies Analysis

Case Study 1: *Barça Innovation Hub* (FC Barcelona, sports club, Spain)

FC Barcelona is one of the most traditional and deeply-rooted football clubs in the history of the sport. Founded on November 29, 1899 by Swiss football pioneer Joan Gamper and a group of twelve football fans, the team has won seventy-four national championships (2019) and twenty-two international trophies (2019), including five Champions Leagues.

Along with Real Madrid, AC Milan and Liverpool FC, FC Barcelona has spearheaded local and international competitions. Historically, the club has maintained a notable level of competitiveness, collecting a myriad of successes in its more than 100 years of history. However, its coveted position has been threatened in the past few years.

In 2003, Russian magnate Roman Abramovich bought Chelsea, a London-based football club, for 200 million euros. This business investment, justified by the opportunity to acquire a competitive workforce, a stadium of its own, two hotels, and an entertainment center[3], revolutionized the entertainment industry. This event aroused the interest of large business consortiums and wealthy entrepreneurs in the management of sports clubs, taking the place that had been originally held by local businessmen with strong emotional ties to the club and the city.

Years later, this team-acquisition phenomenon would spread to other football teams like Manchester City FC, Arsenal FC, Liverpool FC, Valencia CF, AC Milan, FC Internazionale Milano Paris Saint-Germain FC, or AS Monaco, among others. The unexpected entrance of these new players represented a radical innovation in the business model of these organizations, completely modifying the way they competed, resulting in a quick and profound professionalization of already established institutions, built into organizations (FC Barcelona. Real Madrid or Bilbao Athletic) or still the property of local businesspeople (Juventus FC, FC Oporto or Atlético Madrid).

Faced with this new competitive landscape, FC Barcelona decided to bet on Big Data as a differentiating element, aware that in order to compete in this new global stage, it needed to leverage the club's assets. Since 2010, it has been using a centralized data system called COR (the Spanish acronym for Knowledge, Organization, and Performance) to improve its internal and external processes.

It currently has a budget of 1 billion euros (2019-2020 season)[4], in addition to 300 million fans all around the world and 4.5 million people visiting its stadium every year. The institution has attained high levels of professionalization over the last few decades, inspired by a business model based on sponsorships, youth teams, technology, and innovation. Since early 2010, this bet on innovation has translated into a firm commitment to Big Data, with the aim of maintaining its leadership position.

Table 4 summarizes the key elements of FC Barcelona's Big Data strategy.

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[3]   This is how Valeri Dragánov, deputy and vice president of the Russian Football Union, described Román Abramóvich's operation (https://elpais.com/diario/2003/07/03/deportes/1057183206_850215.html).
[4]   www.marca.com/futbol/barcelona/2019/09/19/5d836f96268e3ef2188b4574.html

Table 4. Key Elements of FC Barcelona's Big Data Strategy

Organization	FC Barcelona
Foundation	1899
Nationality	Spanish
Type of Organization	Non-profit sports organization
President	Josep María Bertomeu (2014.-)
CEO	Òscar Grau (2016.-)
Technical Director	Ernesto Valverde Tejedor (2017.-)
Background	Creation of a proprietary centralized data system called COR (Spanish acronym that stands for Knowledge, Organization, and Performance) to improve its internal and external processes.
Problem	Emergence of sports institutions with greater financial strength, focused on hiring technical and managerial talent, bringing about an immediate improvement in their sports results, attracting the attention of fans, sponsors, and the media, triggering a strong sports and business rivalry.
Challenge	Successfully competing through the efficient administration of the organization and the sustainable increase of the available resources, all of this with the objective of attracting more and greater revenues and retaining the best human capital, preserving their football style and promoting early talent detection.
Context	Creation of a proprietary centralized data system called COR (Spanish acronym that stands for Knowledge, Organization, and Performance) in 2010, in order to improve its internal and external processes.
Big Data Proposal to Solve the Problem	Taking advantage of the data that has been collected with COR since 2010 in order to identify and create a collaborative ecosystem that not only multiplies its information-collection sources, but also allows for the creation of a relevant and strategic network of knowledge based on the establishment of an academic, technological, and business collaboration with the leading actors in the industry and also with actors that have a high growth potential.

The genesis of Big Data use by FC Barcelona's management dates back to 2010, when the club's sports management realized that barely any information was being collected beyond their players' medical leave records. This led its directors, Andoni Zubizarreta Urreta and Albert Valentín Escolano, to take on the task of reverting this situation through the creation of a more intuitive, more technological, and quicker system to collect relevant data, which they called COR (meaning *heart* in Catalan, whose three letters refer to the Spanish words for knowledge, organization, and performance).

The COR system is housed in a high-density server room located underneath gate 49 of the Camp Nou stadium. These servers obtain all kinds of data from players, whether professional or youth, part of the club or possible transfers, ranging from medical and sports data to videos of their performance in matches and training sessions. Its features allow the managers and the technical staff to establish whatever parameters they see fit in order to screen the player list and, thus, be able to discover talent andsign the best players.

COR allows for easier management, as the knowledge is within the reach of all the trainers, who can systematize and analyze the training sessions and matches so that the teams can improve. When they need to decide which players to sign, the system takes the information available about each prospective player, which can be around two dozen reports, and runs it through three filters (description, evaluation, and suitability) that have already been established and defined by the Sports Area. The club has dismissed the possibility of commercializing the COR system, as they consider it a tailored program that is completely in line with the club's philosophy, and they regard it as a differentiator that yields a competitive advantage.

In 2017, the system's success led to the creation of the Barça Innovation Hub (BIHUB)[5]. This initiative centralizes all the club's Big Data with the aim of creating an ecosystem of collaboration with brands, universities, research centers, startups, entrepreneurs, students, athletes or investors. The BIHUB is divided into seven areas of knowledge:

1. Team sports
2. Sports performance
3. Analysis and sports technology
4. Health and wellness
5. Fan Engagement and Big Data
6. Smart facilities
7. Social impact

Many sports institutions are betting on innovation through the smart management of Big Data. However, the uniqueness of this system implemented by FC Barcelona lies in the management of an ecosystem of work and network collaboration with all kinds of innovative agents, which is at the center of the entire model, raising data to a strategic priority, not just in the information obtention mode, but especially in the information generation and management one. This ecosystem is regarded as the most ambitious bet in football today, making FC Barcelona and, therefore, the city of Barcelona, the backbone and accelerator of the knowledge industry.

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[5] www.barcainnovationhub.com/

Figure 1 shows the main actors of the *Barça Innovation Hub* ecosystem.

Figure 1. Barça Innovation Hub Ecosystem
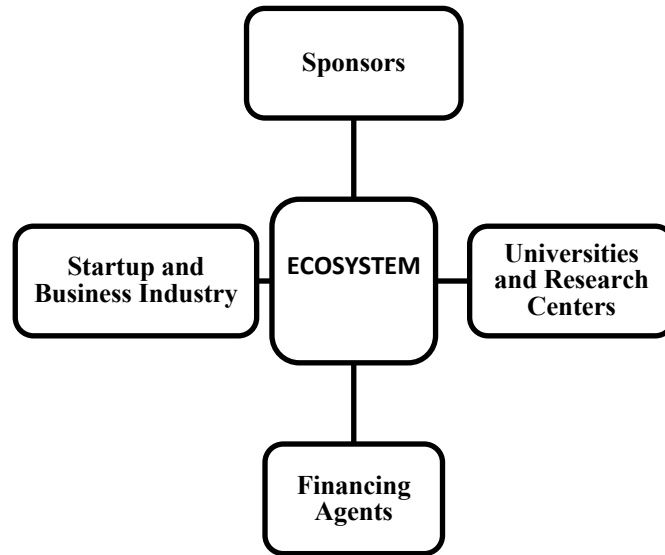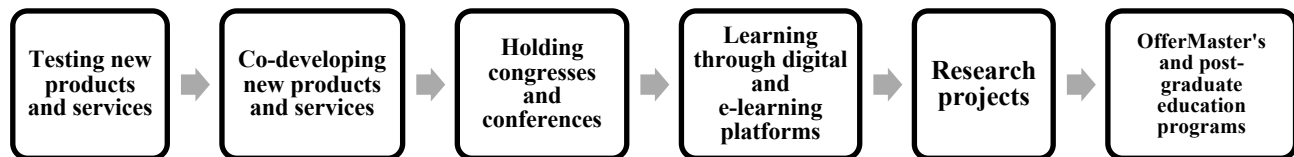

Source: Designed by the authors

When the hub first began operating, its first commissioner, Jordi Monés i Carilla placed special emphasis on the need to innovate in order to continue creating value and, therefore, to continue competing successfully (see interview in **Exhibit 2**). Nowadays, the person in charge of the hub is director Marta Plana i Dropez, who has injected new impetus to the organism, re-shifting its focus to capturing value through knowledge:

"With the Barça Innovation Hub, we have opened up our knowledge to the world,
to learn from others and exchange knowledge with the best.
In order to grow, we need to share our knowledge and go find what we do not have.
We are convinced that this is the best way to walk
more quickly and more effectively toward the future.
Sharing knowledge means adopting a strategic leadership position.
It allows us to be more flexible and to adapt more quickly
to these changes that are to come. Now, we are 'more than a club'
because we bet on innovation and knowledge development[6]".

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[6]   www.fcbarcelona.es/es/noticias/1149833/el-barca-innovation-hub-cumple-dos-anos-consolidado-como-la-plataforma-de-conocimiento-de-referencia-en-el-deporte

Marta Planas i Dropez[7] was recruited by FC Barcelona in September 2018, as one of the most capable minds in the technological arena. Among her most strategic decisions made at FC Barcelona, we could mention the creation of a fund, Barça Ventures, announced in May 2019, whose mission is to raise 120 million euros from international investors[8]. **Figure 2** summarizes the main stages and the way the Barça Innovation Hub works.

Figure 2. Stages of the Barça Innovation Hub Process

Source: Designed by the authors

After two years operating, the Barça Innovation Hub has yielded the following results:

Development of more than 70 scientific research projects and co-development of 8 projects with startups, some of the most relevant among them being:

- **Collaboration with WIMU**, a company specializing in Ultra-Wide Band technology to track athletes' biometric data, which uses a type of technology that is more precise than GPS.
- **Development of AI-based algorithms** with the aim of recognizing tactical patterns that identify each player's control, generation, and occupation of space when they do not have the ball. This way, they can start to define which movements could more easily lead to a play that could result in a goal.
- **Sleep study**, promoted with the Allianz Group, incorporating information from an intelligent t-shirt developed by Canadian startup Hexoskin, with the purpose of measuring its possible impact on sports performance and health.
- **Development of a personalized profile of players' hydration** during the games and training sessions, with the support of Gatorade.
- **Adaptation of the Camp Nou** stadium to 5G technology, with the support of GSMA, which will allow them to explore new ways of broadcasting, and later, marketing content.

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[7]   A Bachelor of Laws from the University of Barcelona and Juris Doctor (summa cum laude) from the New Southeastern University, she completed her studies at the University of Stanford and the London School of Economics. She has had a very successful career. In the technology sector, she was vice-president of regulations at Cabify (2018-2019); she also worked as a lawyer at Baker & McKenzie (2002-2004), a legal advisor for Microsoft Corp (2006-2007), head of IT at Osborne Clarke (2007-2010), and she was co-founder of Pagantis (2015-2018), the first Spanish Fintech to obtain a payment service license from the Bank of Spain.
[8]   www.crunchbase.com/organization/bar%C3%A7a-ventures

Organization of eight (8) Congresses in the organization's facilities, which has gathered more than 2,300 attendees. Some of these have been the *Barça Sports Medicine Conference*, the *Sport Technology Symposium* or the *Football Coach Analytics Summit*.

Promotion of seven (7) on-campus Master's degree programs and online education for 10,000 students from more than 100 countries through institutions like MIT in Boston, Georgetown University, the University of Pekin, ESADE, the UB, the UAB, the Johan Cruyff Institute, the INEFC or ISDE, through *Barça Universitas*.

Alliance with Facebook, to become the first sports organization to develop and use its new service called *Fan Subscription*, a digital fan club in which subscribers will be able to have access to a wide range of exclusive contents.[9]

Case Study 2: The Aspire Academy in Qatar

Qatar is a sovereign Arab State located in western Asia with 2.6 million inhabitants. The country is home to the third-largest natural gas reserve in the world, which has turned this small emirate into the nation with the highest income per capita in the world. In 2004, it built the Aspire Academy for Sports Excellence, with the purpose of becoming a global benchmark in the world of football.

The Aspire Academy for Sports Excellence is the largest sports performance center in the world, and it was founded in 2004 as an independent agency closely linked to Qatar's public institutions, which have their eye on the successful observance of the 2022 Football World Cup for purposes past the arena. They are developing systems that can identify talent to enhance their national football team, and they also intend to apply these insights to enhance their infrastructure, communications, and technological development.

The Aspire Academy is also the visible part of a giant iceberg structured by Qatar to become one of the great world powers of this sport. The Qatari Royal Family has spared no expense, establishing a powerful network of entities, directors, trainers, football players, football teams, engineering companies and software firms and, in a short period of time, they have transformed the nation into a clear benchmark in the world of football, connecting all the efforts through the use of Big Data.

Table 5 describes the main elements of the Big Data strategy of Qatar's Academy for Sports Excellence.

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[9]   www.fcbarcelona.es/es/club/noticias/1350173/el-barca-es-seleccionado-por-facebook-para-convertirse-en-el-primer-club-deportivo-que-implemente-su-nuevo-servicio-fan-subscription

Table 5. Key Elements of the Aspire Academy's Big Data Strategy

Organization	Aspire Academy for Sports Excellence
Foundation	2004
Nationality	Qatari
Nature	Independent institution promoted by the Qatari government with close ties to the country's Olympic Committee and the Supreme Education Council.
CEO	Iván Bravo (2011.-)
Technical Director	Edorta Murua Zenarruzabeitia (2017.-)
Problem	Qatar is not a country with a football tradition; the national football team has never competed in a World Cup, and its Football League is not known as the most competitive one in the Middle East.
Challenge	In 2010, Qatar was selected to host the 2022 World Cup, along with its national football team. The Royal Family has considered this to be of great strategic interest to reinforce the country's global image. It will allow the country to attract foreign investment with which to reduce its financial dependency on hydrocarbons. To this end, it deems it indispensable for the event to be managed in a professional and modern fashion, and to for its football team to have an excellent technical performance.
Background	The Qatar Football Association was founded in 1960 and, since 1970, it has been a member of the *Fédération Internationale de Football Association* (FIFA). In 2003, the Qatar Football Association allowed the clubs that were part of the country's Football League to hire foreigners, which enabled it to sign players such as Gabriel Batistuta or Josep Guardiola. The Qatari League modified its statutes in 2008 in order to evolve to a completely professionalized structure.
Big Data Proposal to solve the Problem	Early talent detection among Qatari football players aged 13 to 25 in order to improve the performance of its national football team in the 2022 World Cup, framed within *Aspire's Football Data Management System (FDMS) project*. Construction of state-of-the-art stadiums technologically connected through an optimal communications infrastructure that will result in an excellent level of satisfaction from both participants and spectators. They seek instant data connection for mobile devices and social networks to promote first-level engagement.

During a closed session that took place in Zurich on December 2, 2010, the Executive Committee of FIFA, the most important football organization worldwide, designated Qatar as the host of the 2022 World Cup. Qatar's emir, Sheikh Hamad bin Khalifa Al-Thani, recognized the implicit responsibility that came with this nomination, committing to live up to the expectations that were being placed upon the country:

" We thank [FIFA] for believing in change and for [its] efforts to widen the borders of the game and give Qatar this opportunity. You will be proud of us and the Middle East. This I promise."[10]

The projection of the event is a top priority, as the volume of investment in Qatar's sports sector market is expected to reach 20 billion dollars in 2022, attracting sports service, legal, education and entertainment, clothing, and sports equipment companies,[11] which will allow for the diversification of the country's economy, currently strongly dependent on hydrocarbons. Therefore, the challenge the country is facing could be divided into two categories: 1) Offering an excellent sports performance through its national football team and 2) Creating an extraordinary impression on sponsors, companies, and visitors.

There are three milestones that have marked Qatar's football strategy. First, the foundation of the Aspire Academy in 2004, with the aim of developing football talent, followed by its sponsorship agreement with FC Barcelona during the 2010-2017 period,[12] and finally, the hiring of Iván Bravo, former strategy director for Real Madrid, as director of the Aspire Academy in 2011, who brought two other experienced professionals to work on the project with him. It is worth noting that the strategic alliance with FC Barcelona allowed the Qatari institutions to become familiar with a football model geared toward detecting and then training sports talent through its academy, "*La Maisa*," which is known around the world as the place that gave birth to renowned players such as Víctor Valdés, Carles Puyol, Gerard Piqué, Josep Guardiola, Cesc Fábregas, Thiago Alcántara, Pedro Rodríguez, Andrés Iniesta, and Lionel Messi. This relationship allowed the country's authorities to get to know the technical staff and directors that were immersed in the football growth of these prominent individuals, some of which have ended up joining the Aspire Academy, teams that are part of the country's league, and other football organizations, including the current technical director of the country's national team, Félix Sánchez Blas[13].

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[10]   www.es.fifa.com/news/qatar-anfitrion-del-mundial-2022-1344732

[11]   Estimates offered by Yousuf Mohamed Al-Jaida, CEO of the Qatar Financial Centre (www.lta.reuters.com/articulo/qatar-inversiones-idLTAKCN1Q60IU-OUSLT)

[12]   "The Club signed a sponsorship agreement with QSI (Qatar Sports Investment), which designated the Qatar Foundation as the organization representing Qatar in its collaboration with FC Barcelona. The Qatar Foundation is a private and independent non-profit organization that was founded in 1995, whose mission is to support Qatar in its transformation from an oil- and gas- dependent economy into a knowledge economy. The Foundation intends to release human potential thanks to three pillars: education, science and research, and community development. The benefits will not be limited to Qatar, but rather, they will extend throughout the entire region and the rest of the world." (Annual Report 2010-2011, FC Barcelona).

[13]   www.efe.com/efe/espana/destacada/la-corona-asiatica-entre-el-metodo-de-masia-y-renovacion-samurai/10011-

In 2015, in its search for results, the Aspire Academy signed a collaboration agreement with GolStats, a Mexican company founded in 2012, that uses Big Data to collaborate with football club directors and the heads of national football teams in order to help them make better financial decisions, analyzing all of the players and determining which of them are the best fit to join the line-up. To reach this objective, GolStats developed a unique software tool to create, manage, and benefit from the quantity and complexity of the data generated in football, such as information about the players, teams, matches and competitions, training sessions, scouting, tryouts, and operations (see **Exhibit 3**).

In 2016, the senior vice-president and global general manager of sports and entertainment company SAP, Stefan Wagner, and the general manager of the Aspire Academy, Iván Bravo, announced the partnership of both organizations with the objective of offering real-time data of the athletes' development and the management of sports operations on any mobile device. In 2017, FC Bayern Munich, joined the agreement, with the intention of sharing experience and knowledge in order to improve the fans' experience.[14] The purpose of this partnership was to create a platform from which all the stakeholders would have access to the data and information that they needed. The benefits are not only for the Aspire Academy, but for all the sports in Qatar.

It is worth mentioning that the World Athletics Championship, which took place in Qatar in September 2019, had some organizational deficiencies, especially in terms of the coordination of activities and the presence of the audience, which were not due to any structural problems the country might have had, but rather, to a lacking schedule arrangement and event programming, which could largely be corrected through the use of Big Data, like the data that has been gathered since 2017 with SAP's help. The following are the most notable achievements that have been attained through this tool:

Reception of information about more than three (3) million young Qatari football players,[15] not just from the academy, but also from the local league, developing analysis, interpretation, and decision proposals through monitoring local players to determine their performance, strengths, weaknesses, and areas of improvement.

Obtention of better results in tournaments: The Qatari national team won the Asia AFC U-19 Championship in 2014, with a team whose players had all gone through the Aspire Academy. In 2019, the complete national team, trained by Félix Sánchez Bas, won its first international title, beating Japan (1-3) in the final of the Asian Cup that took place in the United Arab Emirates.

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[14] FC Bayern Munich has been using real-time technology to react more quickly to the 30,000 fan comments it receives every hour through its digital channels, to keep the players healthy and to offer new products and services in response to fans' demands (https://www.aspire.qa/news.aspx?id=1598).

[15] www.novofutbol.com/2019/04/24/aspire-academy-conoce-la-mejor-escuela-de-futbol/

Discussion

Implementation Process of a Big Data Program in Football Organizations

After the analysis conducted in this document, we believe it is necessary for football clubs to venture out to implement an information scaling program that will allow them to take advantage of the full potential of Big Data. This program could comprise the following seven stages:

Stage 1: Clearly determining the goals that they intend to accomplish, determining the questions they are going to ask and what kinds of answers they wish to obtain.

Stage 2: Classifying the information that is needed to obtain these answers, their sources, types, and applicable quality criteria.

Stage 3: Diagnosing which operations need to be undertaken in order to have access to these data, as well as the most appropriate technological tools (software and devices) for each case.

Stage 4: Evaluating whether it is necessary to persevere in the means to obtain these data and, if applicable, where and how to persevere (registration to databases, spreadsheets, platforms).

Stage 5: Studying the transformation and enrichment workflows that are to be produced to transform the entry data into valid sources for the analytical processes that must generate the answers anticipated in the first stage.

Stage 6: Analyzing the volume of datasets, both regarding their current size and their growth rate, in order to determine the most appropriate solution.

Stage 7: Defining which organic restrictions affect the data and the processes we have identified, specifically information security, privacy or quality issues.

These stages represent a starting point, which is meant to trigger the successful use of Big Data in a football organization, as it represents a similar origin to the one experienced by FC Barcelona in 2010 with its proprietary system, COR, or the Aspire Academy in Qatar since 2010, with the support of SAP and GolStats.

We deem it essential to have a scaling program that results in the appropriate classification and hierarchization of data to prevent contamination or unnecessary excess of information, having access to clean and veritable data that responds to the needs and concerns of the football organization, so it is extremely relevant to incorporate professionals who can contribute new competencies and skills, in order to reengineer the processes of the Data and Technology areas (led by a Chief Data Officer and a Chief Technology Officer, respectively).

Limitations to be Considered

It is important to bear in mind some of the following intrinsic and extrinsic limitations of a strategic Big Data program. First, data science is not yet able to properly evaluate the emotional component, such as the frustration, demotivation or disappointment felt by an athlete, which also influences his or her performance. This has implications both on a professional and a personal level because, even though it is not directly linked to athletic performance, it can considerably affect it.

The *dirty* data phenomenon should also be considered because, sometimes, we have data that contains a large amount of noise, i.e., information that is unhelpful or irrelevant, and sometimes even misleading. For this reason, organizations have to be careful with the way they handle and refine databases (Poynter, 2014). It is also important to keep in mind that the data obtained through the analysis have a specific validity period. It could be said that they are often merely a snapshot of a precise moment in time. This is due to the fact that data are continuously moving and changing. In other words, they can have an expiration date; therefore, it is essential to periodically re-analyze data in order to keep them up to date.

There is also the issue of security, as there is a risk that the knowledge of a football organization could be extracted by hackers. For this reason, sports institutions require digital security experts as well as information management protocols to protect themselves from this threat and new types of crimes against intellectual and industrial property.

Furthermore, the new knowledge and skills required by the introduction of Big Data into the technical and managerial realm of football teams deserves our attention. This leads to the implementation of continuous training programs and mental preparation for the protagonists, with the disadvantage that some of the big personalities in the industry will not be able or willing to readapt to this new ecosystem in which the use of data technology is becoming indispensable.

Last, but not least, is the ethical debate revolving around Big Data, which addresses the fact that this large volume of information that interferes with the privacy of athletes and the transparency of their clubs could cause or generate unfair treatment, or even anticipated punishment, undermining the genuine identity of some of the football players.

Conclusion

It is evident that the introduction of Big Data into football has revolutionized the entire industry, improving players' capabilities and helping them to improve their performance, providing the technical staff with the opportunity to predict and make relevant decisions regarding their line-up. It is also undeniable that its implementation has had an impact on information management, allowing teams to make thorough evaluations like never before. This has helped to prevent injuries and diseases, and it also has visible factors and variables that did not use to be taken into account.

The aforementioned has reconfigured some traditional roles and activities in the technical environment, which are evolving toward a profile that is more similar to a data scientist's. This situation is reshaping the sense and reach of the concept *"human factor,"* evolving the requirement of skills and competencies in this field.

The impact in the management of a football organization is no less significant, as it has represented additional income and savings derived from a smart rationalization of the available resources, mitigating the risk of making erroneous investments. All in all, it is also true that the application of this technology is mutating the concept of "competition," creating considerable gaps between organizations depending on their level of technological development. Therefore, in our opinion, it is highly probable that, in the future, not all organizations will be able to compete on even ground, not just due to the financial aspect, but especially due to the dependence on these applications and devices.

The strategic move of some football organizations like FC Barcelona or Real Madrid to prioritizing the application and exploitation of Big Data with the expectation that it will help them to improve their productivity and competitiveness before organizations with greater financial strength is particularly relevant. In our opinion, this is a wise decision, which repositions clubs to the center of the scene, giving them a leading role in the deployment and promotion of innovation, and providing them with the opportunity to have talent counter economic potential.

Nevertheless, it could be expected that other football organizations could also imitate this move in the future (particularly those with a direct connection to the Qatari organizations, such as Paris Saint-Germain, property of Qatar Sports Investment (QSI), represented by Nasser al Khelaifi). In any case, the generalization of Big Data as a key variable in the decision-making processes of sports clubs seems to be a one-way street, endorsed by the improved results it has been offering to different organizations, whose cases have been stated and analyzed in this study. We can identify their potential impact on three fundamental aspects:

1. **Detection and growth of human capital**
   (both technical and managerial)

2. **Optimization of internal operations**
   (savings and efficiency)

3. **Transformation of consumer and business experience**
   (value co-creation with spectators and sponsors).

Also important is the more than likely alliance among some regional leaders with a global vocation to be able to compete in this new market with already-established giants such as IBM, Microsoft, SAP or Google. As an example, we could mention the recent and very revealing collaboration between Huawei and Telefónica-Movistar,[16] which serves as precedent for other large companies. In this respect, we could foresee that mergers and acquisitions will be taking place in the Big Data industry, especially when it comes to the progressive emergence of startups that could join forces and even be susceptible to acquisition from larger companies.

In spite of the limitations previously mentioned during the discussion, some of which could be partially solved by future technology as well as through regulations or legislation at a country level or through clubs' internal rules and guidelines, we are convinced that the experience that is brewing in the realm of football is bringing about a similar revolution in other sports organizations that hold team competitions, such as basketball, American football or baseball.

This revolution in the use of data will impact individual sports such as tennis and athletics, and, consequently, it will considerably affect the new ways of competing that are experiencing an important boom, such as e-Sports. Likewise, it is very probable that other entertainment industries will also experience their particular Big Data boom when setting a strategic course, mainly the music, film or literature industries.

We find ourselves in an advanced stage of a burgeoning data culture that promotes the modernization of the decision-making process. This is a time for science and innovation, which will result in a renewed ambition for business success based on the search for high-impact goals through data analysis. To this end, organizations will need to carry out dynamic activities based on precise, quick, useful, and profitable measurements through indicators and metrics that were not available before and are now within their reach.

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[16] In March 2018, *Telefónica Business Solutions* and *Huawei* signed a global agreement to develop a network services and CloudVPN platform for companies, with the purpose of accelerating the adoption of digital services in the small and medium enterprise market (https://www.europapress.es/economia/noticia-telefonica-huawei-firman-alianza-global-acelerar-digitalizacion-pymes-20180309115949.html).

Exhibit 1: Timeline of the most important milestones of Big Data in Sports

Year	Event Description
1969	Foundation of company SAP (initially called: "*Systemanalyse und Programmentwicklung*").
1972	Hamilton launches Pulsar P1, the first smart watch (*wearable*).
1985	• Launch of Excel by the Microsoft Corporation. • Publication of the book *The Bill James Historical Baseball Abstract,* highlighting the value of statistics in the sports world, namely baseball.
2000	Catapult Sports develops its first experimental prototype for a smart vest (*wearable*).
2002	• Opening of the Milan Lab by AC Milan to reduce physical injuries. • Statistical success of baseball team Oakland Athletic.
2006	Nike and Apple launch the personal training application called Nike+.
2010	FC Barcelona implements its computer program COR (Spanish for Knowledge, Organization, and Performance).
2013	• Use of statistics by the Mexican national football team. • The Golden State Warriors set up a camera system to improve their defense.
2014	• The Germany Football Federation hires SAP and wins the FIFA World Cup in Brazil. • Agreement between Real Madrid and Microsoft
2015	The Tour de France obtains real-time data from bicycles, synchronizing all the information.
2016	• SAP launches SAP Sports One for football in different Latin American countries • Mexico's Club América hires SAP Sports One.
2017	• Creation of the *'Barça Innovation Hub'* by FC Barcelona. • Baseball team Houston Astros takes home a league title thanks to a complex data-analysis system.
2018	• American Football team Philadelphia Eagles win the Super Bowl using a new data system. • Use of the *Edge Computing* technology to live-stream the Davis Cup's tennis playoffs.

Source: Designed by the authors

Exhibit 2: Interview with Jordi Monés i Carilla

Jordi Monés i Carilla, Director of FC Barcelona
Commissioner for the Barça Innovation Hub until October 2017

Interview conducted by Jesús Pérez Ramos for the "Mundo Deportivo" newspaper, published in Spain on April 3, 2017.

www.mundodeportivo.com/futbol/fc-barcelona/20170403/421420632499/mones-si-el-barca-no-innova-nos-adelantaran-y-no-estaremos-arriba.html

How has the inception process for the Barça Innovation Hub (BIHUB) been?

The project has now had its "debut," so to speak, but this is something that we have been working on for more than a year. We have structured the department, although we have also inherited things and departments that the club already had. The medical area and the performance area had already been operating for many years, but it is true that the different departments were kind of marching to the beat of their own drums. What we have done is organize all of this, meaning we have made a structural and transversal project, with people working exclusively on this full time, and we have also expanded this to all the areas that are related to the sport, namely technology, team sports, social sciences and communication, marketing, sports law, and so on. These are five areas that are now structured as part of one strategic project. It is a project that we want and a project that we need. It is not something we are doing now because we want to be innovative, but because it is necessary. Barça should always be in a position that is conducive to success.

The bar is set so high that, if we were not constantly reinventing ourselves, we would lose the possibility to be first. Everyone moves, and all teams do things and, in order to be slightly ahead of the pack, we need to do great things in research and innovation. To be a hundredth of a second faster when swimming, you need great training, and the same is true here. You need to make a lot of efforts to have a slight advantage over everyone else. And, should you fall asleep, others will pass you by. This is a necessary area.

Barça, on the other hand, is a very peculiar and unique club. We need to get players to injure themselves less, to win more; we need to sign the best players, to have the best contracts… Our club is not always able to compete against other clubs in monetary terms, and we need to even the playing field somehow in order to attract players without having that money. We definitely need to be constantly reinventing ourselves.

There are many models that are betting on innovation, and different clubs are choosing different paths. What made Barça decide on this model?

Yes, it is true that clubs are doing different things. There are even some clubs that are not part of the "top 10" doing things related to innovation, because they have seen something that others will see and that perhaps we have seen before others, which is that, as long as you refuse to innovate and reinvent yourself, you will not be on top. We need to stay up to date on everything, and that means being up to date with what others are doing, and being very aware that, if there are others who know more than you, you need to go out there and find them in order to learn.

We have a very open system; we partner up with people who have similar projects, whether they are universities, technological centers, companies or enterprises. Sometimes we will basically develop things ourselves, and sometimes we will just participate. What Barça will never be is a technological center. That would be very pretentious; we are a sports club. We won't be a university either, but we *can* add specific added values inherent to Barça to university programs.

For example, in the relationship we have with Gatorade, they have a hydration and nutrition laboratory system, and we make our elite players available to them so they can test their products. It is a collaboration of this kind, a network. Nowadays, everything works like this; you cannot have a research facility in a building and be done with it, but rather, it is done with work groups that can be here or anywhere else in the world. We are moving with this commitment to creating networks in order to become a benchmark in the world of sports and technology.

There are some fields in which Barça is quite ahead of the curve, and even a leader, but there are surely others that still have a long way to go. Which would be each of these?

In sports medicine, there is no doubt about where we stand. This is so due to the obligation we have by having a top team for many years, with many sub specialties and lots of resources invested. We have a sports city with a medical center, which is the only football medical center in the world that is recognized by FIFA. There are other hospitals that are recognized by FIFA, but as a medical center, and as doctors, we make sports specialists. This will not save us from getting injured tomorrow; we could have many injuries, but by doing all of this, you manage to lower the chances. There is another area that has had a lot of interaction with the medical field, which is performance and data analysis. We have also been working on this for years, particularly since 2010, when we incorporated the performance area as part of the medical area. We have worked a lot on the GPS. Back then, almost nothing was being done, and now, we are not only using the data to do real things, like designating rotations or designing players' training sessions, but FIFA and the Spanish League have allowed this to be used during matches, which was something that was not possible before. Barça has had a hand in this. In these areas, we are clearly well positioned.

In the technology area, we are also well positioned, because in terms of social networks, we are the club with the highest number of followers. There is also a continuous technological and digital effort here. In terms of sports management, we have had a unique and peculiar model. When it comes to playing systems, without a doubt, our system is unique. This is perhaps an area about which we will share information only to a certain extent; we will share generic things, but we cannot share a trainer's specific tactics, because that falls within the confidentiality that we need to maintain to be able to defeat the others. However, there is still much to explain.

Barça's playing system, which is quite transversal at all ages, as well as the issue of performance and training, which we intend to not only apply to football, but also to the other professional areas, are also pretty unique. Actually, there are many things that Barça does in order to function that are pretty unique. We are the most local club, with a strong bond to Catalonia and its partners, but also one of the most global ones.

This means that we need to have two different technological visions to meet the expectations of two very different types of fans. Our social involvement in values also makes us very different. One of the examples was that of '*Camp Nou sense fum'* (Camp Nou without smoke), something unique that has not been done in any other stadium in Spain, or in any European stadium that has not been compelled to do so by law. There are very unique things that Barça has done, because it has the characteristics of something that is much more than a club, because in many ways, it really is. This has made us do things that others don't do. We are well positioned in all these things.

The European Commission was impressed when it saw that, of our own accord, we had made our stadium smoke-free, and it wanted us to be the image of its campaign across Europe. Now, we have not been wrapped up in ourselves. Everyone is moving, everyone is smart, and there are clubs that have great people. As soon as we start thinking we are too good and ahead of the pack, we will easily begin to be overtaken left and right. We need to make a lot of efforts to have the possibility to continue leading this race.

In addition to the medical, performance, or playing system issues, are issues such as the fans' experience, ticket sales or digital content sharing a part of the Barça Innovation Hub?

There are parts that are and parts that are not. There are many areas of the Barça Innovation Hub in which the people who work there are exclusively working there and, other times, these people have two functions, one at the Barça Innovation Hub and a day-to-day one. In "ticketing," for instance, there are things that are day-to-day issues, but then there are things that, even if they are structural, you are thinking about where they do it better, how we could do it better, etc. Regarding the issue of "fan engagement," we have a lot to learn about how a lot of things are done in shows in the United States.

When you see a super Bowl, of course you say: "We need to learn," because they have this whole production and show that we do not yet have here. And now, with the whole "*Espai Barça*," with which we will build a smart stadium, it is also clear that we have the possibility to do something completely new. The "*Espai Barça*" is not part of BIHUB, but there are things that are very linked. When the technology symposium we held took place, people from Universal Studios came, and we talked about smart stadiums, so a lot of things are linked.

Will Barça put in motion a tool or methodology to transmit this knowledge "inwards"? How will it be used?

I tell my people that, in many ways, we will run things like they do in a clinical trial. For example, we will go to China, we will do a project with one "partner," and it will be like a concept test, like a clinical trial. For this to be approved and become a medication, we will need to send it to the marketing department, the media department or whatever department necessary. We will run the tests, and then the club will use them in the areas that have a normal day-to-day development. We are a kind of laboratory to test things; some of those things will not work, and others will be validated and implemented. The professionals at the Barça Innovation Hub are very good people. We have taken some people from very important positions at the club, and they are working full-throttle on this. And not only do they all believe in this, but they are having fun doing it, because being in a place that is there to innovate, to think differently, and to create is a lot of fun.

As Barça, we have an advantage, which is that, if tomorrow we call a large American company to do something together, they are in or, at least, they are interested. Then, perhaps they tell us that they will not participate, but in general, it can be interesting for them. Our brand is so powerful that partnering up with us could be advantageous for other companies. We need to take advantage of all of this in the best way possible; we need to be aware of this influence that we can have to attract people and do things with them. Many times, both parties can benefit from that. We are doing this with Toshiba. They have seen that we are a laboratory for their high-resolution resonance; on the one hand, we can have a tremendous machinery beside our players that many companies would kill for, and, on the other hand, we are collaborating with Toshiba. It's a win-win situation.

Exhibit 3: Interview with Viviane Sámano Pacheco (GolStats)

Viviane Sámano Pacheco, Commercial Director at GolStats

Interview conducted by Iván Pérez for the "El Economista" newspaper, published in Mexico on December 12, 2017.

www.eleconomista.com.mx/deportes/Los-datos-ayudan-a-tomar-decisiones-economicas-a-los-clubes-20171212-0120.html

There are still some soccer technicians that prefer observation, their knowledge over technology. What has it been like to work in the Mexican market with this barrier?

Sometimes, a technician or any person can be wary of technology, which is a tool that will aid them; it is not something that will make you win by itself. What we are offering is an X-ray that identifies all the strengths and weaknesses, but you need the coaches' expertise to be able to interpret it. We collect everything, from the distance traveled to the centers and their effectiveness, millions and millions of data. We gather more than 20 million data per match if we apply our virtual reality technology.

How and in what way does the software aid the clubs' decision making causing them to invest millions of dollars every year?

We analyze millions of data that can help the management to make economic decisions, the technical staff to make better sports decisions, the players to learn about their own performance and their rivals' performance. By providing cold data, numbers, we are providing conclusive information. From detecting talent at a very early age in the U-15 or U-17. We make comparative player reports for analysis, all of it to aid or make million-dollar decision making easier and supported by data. We have a tool on the platform that helps to detect the most productive players; I have personally had a chat with a technical director in which we ran a test.

What is it like to work with the Qatar national football team?

With Qatar, we analyze all of their players aged 13 to 25; we never miss talent. We developed a software that allows them to know everything that is happening during training sessions. We created a software especially for them. We work with the Aspire Academy; they are the link. We have been with them for approximately two years, and they constantly ask us to do more. We are beginning the GolStats service, which is the analysis of all the players, the statistical platform with video, and they ask us to be more and more involved every time.

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