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The SportsTech Ecosystem in Barcelona

INTERNSHIP REPORT

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Outline

1. Introduction

The relationship between the city of Barcelona and sport has been consolidated since the Olympics of 1992. The legacy of the Games is still tangible from the sporting infrastructure and above all, from the mentality of Spaniards towards sport. They transformed and shaped the urban landscape of the city; strengthened its attractiveness and position on the world map by positively impacting its image; and created economic and social benefits by generating direct business activity and employment, and by increasing the interest of local people in sport and health (INDESCAT n/a). The impact of the Games was so profound, that over twenty-five years later, they still echo in everyone's memories as if they had happened only yesterday.

The Olympic Games of 1992 exemplify the potential of sport to contribute to social cohesion and economic development. It should come as no surprise that since then, investment in sport has become a crucial component of urban and regional development strategy.

Being home to major sports clubs and sportsmen and women, to leading local and foreign companies and brands, and to fine sports facilities, and being a host to renowned international sports events, means that Barcelona is considered to be one of the world sports capitals (INDESCAT n/a). The traditional sports ecosystem is complex and made up of diverse realities, all of which are present in Barcelona (Institut Barcelona Esports 2013). Thanks to technology which is advancing in leaps and bounds, and to increasing levels of economic globalisation, this ecosystem is being radically transformed and is becoming more complex than ever before. In particular, it was the application of the latest technologies to traditional industries that brought about this disruption and allowed the formation of new emerging industries. The traditional sports industry is no exception to this trend of innovation, with the emergence of SportsTech.

Startup companies are taking advantage of these trends and leading the way in transforming this sector. The worlds of sport and technology are merging like never before (McCaskill 2018), with every aspect of the traditional sports industry expected to be revolutionised through the application of emerging technologies, ranging from fan engagement to player training and performance enhancement, both at professional and amateur levels. Some examples of these new technologies include virtual and augmented reality, blockchain, artificial intelligence and the Internet of Things, whose applications bring about innovations such as new generation wearables, interactive and interconnected stadiums, tracking systems and advanced analytics (Penkert and Malhotra 2019). Given the great variety of technologies available, and of potential applications, the SportsTech industry is a far-reaching one and comprises both sports consumption and production.

These technology-focused industries often blur state boundaries, intensifying competition between local and foreign actors. Therefore, it has become imperative for policy-makers and for cities to keep up to date with emerging trends and to create an environment that fosters and supports innovation. Emerging industries such as SportsTech are catalysts for economic development, and as such are of great interest to policy-makers (Gustafsson et al. 2016).

The metropolitan area of Barcelona represents an interesting case for research into the SportsTech ecosystem. Barcelona had already experienced a radical transformation with the 1992 Olympic Games, using sport as an economic driving force and transforming the city into a leader in traditional sports. However, in regard to SportsTech, Barcelona is currently falling behind its competitors. Despite being the 3rd city in Europe by number of SportsTech startups, it does not even make the list of top 10 by funding (Penkert and Malhotra 2019).

This report presents an overview of the SportsTech sector in general, focusing specifically on Barcelona. It identifies actors within this ecosystem and analyses the interactions among them. This is done with the aim of developing a deeper understanding of this emerging sector, and to provide strategic recommendations for the Pla Estratègic Metropolità de Barcelona and for the city of Barcelona. This is in order to turn challenges into opportunities, to be able to face global competition and to avoid missing out on the opportunities that SportsTech presents.

1.1. Report overview

The following chapter of this report explains the research methodology employed in this study. The third chapter provides an overview of the global SportsTech sector by analysing its state of development, introducing a framework of the sector and presenting relevant topics, such as the eSports debate. Chapter four provides a more focused analysis of the ecosystem in Barcelona, with insights from startup interviews, a mapping of local actors and an analysis of their interactions. The fifth chapter presents an example of best practice from a competitor city. The final chapter closes the report with some conclusions and recommendations.

2. Methodology

This report presents research that was conducted as part of a summer internship for Pla Estratègic Metropolità de Barcelona. The researcher employed a qualitative research methodology. The study made use of both primary and secondary data. Secondary data was gathered from academic, public and business literature. Primary data collection was carried out through *semi-structured interviews*. The choice of this research method was deemed the most suitable for the early stages of exploration of the given research topic, as it allowed the discovery of important descriptive data and it gave the researcher more flexibility in the information gathering process. A set of questions, to be answered by all interviewees, was prepared. These can be found in Appendix 1. At the same time, additional questions were asked during the interviews to clarify and further expand on certain topics. This allowed the conversation to move from general topics to more specific insights.

On most occasions, interviews were carried out face-to-face. When this was not possible, the interviews were carried out via email, phone, or video call. With the agreement of participants, all interviews were recorded and transcribed for further analysis.

A non-probability purposive sampling technique was chosen in order to obtain a sample relevant to the objective of the study. A total of forty emails were sent to startups or actors in the SportsTech ecosystem, with a brief introduction of the study and an invitation to participate. A total of fourteen interviews were carried out. The list of interviewees is presented in Appendix 2. The researcher used the SportsTech industry framework (Penkert 2019a) as a guide to present a more well-rounded perspective on the topic. Appendix 3 classifies the nine startups interviewed according to the framework.

2.1. Research limitations

Given the emerging nature of the sector, the lack of defined boundaries, a common terminology and a clear definition of SportsTech, identifying prospective interviewees was challenging. In addition, the time-consuming nature of the semi-structured interview method and the constrained timeframe of the internship resulted in a limited number of interviews being completed.

In most cases the interviews were conducted in English, which was not the native language of interviewer or the interviewee. Some interviews were conducted in Spanish. In these cases, they were translated by the researcher at the time of transcription.

Once these limitations are acknowledged, it is important to state that the purpose of this research project is to initiate a process of collecting strategic information and not to present a complete and thorough overview of the SportsTech ecosystem in Barcelona. The list of actors presented in chapter four is by no means exhaustive.

3. The emerging SportsTech industry

The combination of technological disruptions and the actions of entrepreneurs and non-market actors has led to the emergence of a new industry (Gustafsson et al. 2016). As with most industries, the long-established and traditional sports industry is being disrupted by advancements in technology, and cultural changes (Deloitte 2019). Today's sports soports men and women, consumers and producers rely more on technology than ever before.

Deloitte's (2019) report on the sports industry identifies major trends that are expected to disrupt and dominate the industry. For example:

- Technology has lowered the barriers of interaction between athletes and fans, so that *athletes have become content creators*, creating more new commercial opportunities.
- Applications of *augmented and virtual reality* are radically changing customer experience. Fans are more connected than ever before and are virtually 'closer' to the athletes.
- An increase in popularity of real-time *sports gambling* is also considered an important trend in shaping the industry because of the need for real-time data feeds and for transforming the relationship between institutions and governing bodies.
- The newest fast-growing trend is *eSports* – professional multiplayer video game competitions – which has witnessed an increasing involvement by major sports teams and leagues.

3.1. The global SportsTech ecosystem

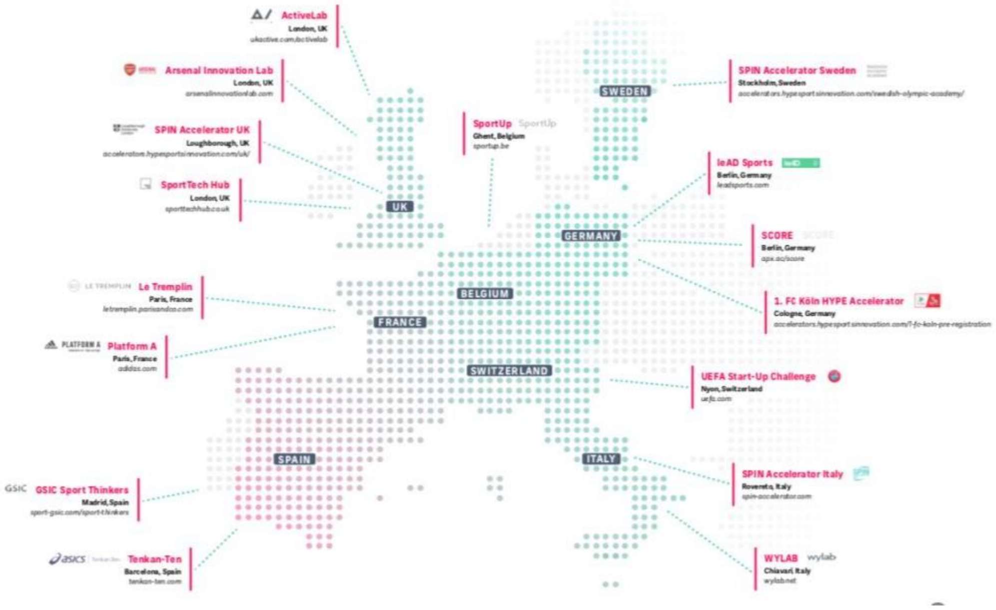
The global ecosystem for SportsTech displays several cities that have become the nodes of the SportsTech network. These nodes connect countries strategically (Castells 2010). In the case of SportsTech, the presence of major dedicated hubs and accelerators helps cities solidify their position on the map in becoming important nodes at European and global levels. Three major trends are identified at a global level.

Increased number of dedicated programmes

With the number of SportsTech startups increasing every year, both the demand for and supply of dedicated accelerators and incubators has also steadily increased during 2018 (Shachar 2018; Penkert and Malhotra 2019). This supports the development of startups by giving them more opportunities to join a programme that specialises in the interest sector, which is strongly advised, and promotes the development of the ecosystem in general (Shachar 2018).

Figure 1 shows a map of the most renowned SportsTech accelerator and incubator programmes around Europe (Penkert and Malhotra 2019). This map is not conclusive, as other initiatives are missing. For example, [Sport eXperience] (Eindhoven), [KICKUP Sports Accelerator] (Lisbon), and many more.

Figure 1 - SportsTech Accelerator and Incubator Programmes in Europe - Penkert and Malhotra 2019



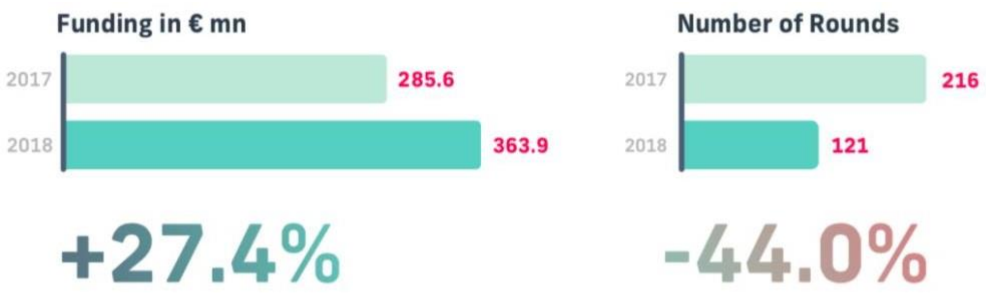
More SportsTech events

Alongside accelerator programmes, the number of networking events and conferences on SportsTech has increased. These events are fundamental for an emerging industry as they shine light on new and upcoming trends and give importance to the growing community (Shachar 2018).

Bigger tickets, less rounds in investment

Industry-wide investment data in 2018 has showed a 27% increase compared to the previous year. Evidently, the fast emerging SportsTech sector is gaining momentum as investors are taking increasing interest (Penkert and Malhotra 2019). Interestingly, this growing investment has shown trends that are typical of an emerging and maturing industry. As is evident from Figure 2, the European SportsTech ecosystem has seen a decrease in the number of investment rounds, but a record high in financial investment (ibid.).

Figure 2 - SportsTech Investment Activity in Europe 2018 vs. 2017 - Penkert and Malhotra 2019



These major trends show positive signs of a healthy and growing market from a quantitative perspective: the money invested, the number of initiatives, and the accelerators and events increasing each year (at least in Europe). It is important to note, however, that the mere presence of dedicated hubs or accelerators is not a sufficient condition for cities to enhance their reputation and to grow the market steadily. It is therefore important to look at the qualitative side of these initiatives to understand what phase of industry emergence SportsTech is currently in and what can be done to support its development.

3.2. The state of development of SportsTech

The phases of industry emergence have no clear-cut boundaries. Therefore, understanding the transition between them might be challenging (Gustafsson et al. 2016). It is important to note that the SportsTech industry operates under a clear label that shapes its identity and provides legitimacy to firms operating under its umbrella. This identity formation is usually typical of the later stages of industry emergence, i.e. the growth stage. Nonetheless, the SportsTech industry is not as mature as one might think. SportsTech-dedicated investment funds are still practically non-existent at European level and those that do exist have not yet managed to raise money. Furthermore, taking a comparative look at the sector, it is evident that it is still at an earlier stage of development with respect to industries such as FinTech and FoodTech.

Even if the trend of industry emergence is global, its phase of development varies depending on geography. It is the actors which take part in a local setting that are important for the development of an industry. For this reason, chapter four will look into the state of the SportsTech ecosystem in Barcelona.

3.3. The SportsTechX framework

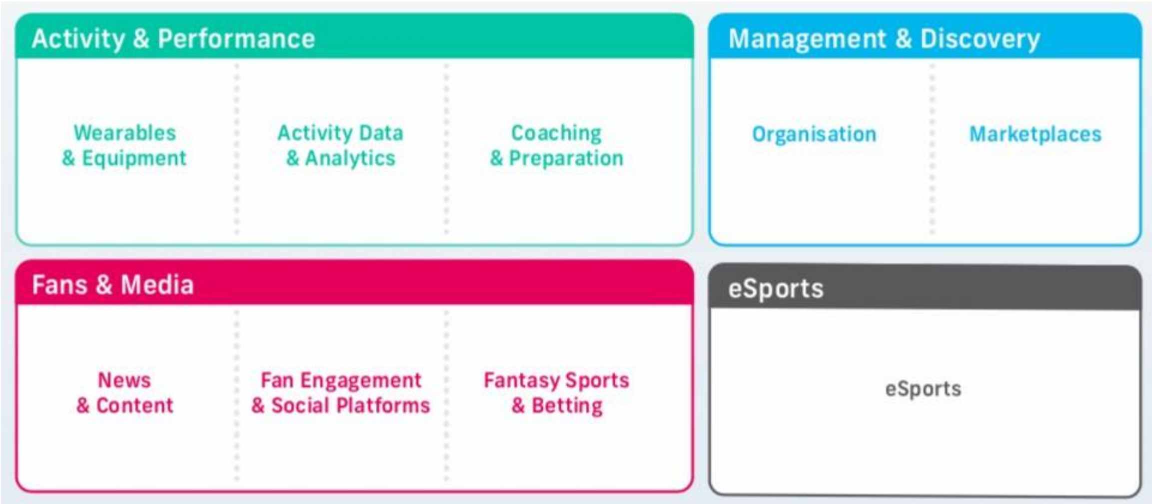
The young and immature industry still lacks defined boundaries and is in need of more awareness, transparency and structure (Gustafsson et al. 2016). In an attempt to create boundaries within and around the emerging sector, the company SportsTechX[1] created a framework for the industry after reviewing thousands of companies involved.

The framework was used as a sampling guide. It also addresses the need for common wording and common understanding within the industry, helping in promoting and navigating through an industry of such breadth. (Penkert 2019a).

[1] **SportsTechX:** The company provides data and insights about SportsTech startups and the surrounding ecosystem with the mission to promote, grow and navigate through the global SportsTech ecosystem.

As evident from Figure 3, the industry is divided into four sectors: Activity & Performance; Management & Discovery; Fans & Media; and eSports[2]. These sectors are then divided into sub-sectors. The eSports sector is not divided into any sub-sector, and in reality its positioning with respect to the traditional sports industry and SportsTech is often at the centre of a heated debate.

Figure 3 - SportsTech Framework - Source: Penkert 2019a



3.4. eSports

The rise of competitive and professional video gaming – known as eSports – was one of the primary technological trends in the past sporting year (McCaskill 2018), with increasingly large audiences and participation (Deloitte 2018). Despite the novelty of the industry, budgets and prizes are extraordinarily high. The global eSports market is forecasted to grow to $1.5 billion in annual revenue by the end of the decade (ibid.). The rapid growth of this industry and the direct access to a demographic which has long been beyond companies' reach are catching the interest of a growing number of big brands and companies that are starting to get involved, either by sponsoring teams or by developing ancillary products or services.

The eSports sector appears to be at an earlier stage of development compared to the overall SportsTech industry. Indeed, although it is growing, overall awareness of the industry is still lacking and regulations are practically non-existent. The nature of eSports in comparison to

[2] ***Activity & Performance***: This sector includes technology applications surrounding the actual physical activity. It is then divided into *Wearables & Equipment*, *Activity Data & Analytics* and *Coaching & Preparation*.
Management & Discovery: This sector includes technology applications to improve running and management of teams, leagues, events and venues, and also platforms to find and purchase sports offerings. It is then divided into *Organisation* and *Management*.
Fans & Media: This sector includes all aspects of how sports content is consumed by viewers and fans. It is then divided into *News & Content*, *Fan Engagement & Social Platforms* and *Fantasy Sports & Betting*.
eSports: This sector includes technology applications in the field of competitive, professional video gaming.

the traditional sports industry and SportsTech is often debated. What industry does it belong to? Should eSports be considered a sport?

The framework of the SportsTech industry presented above considers eSports as a sector belonging to SportsTech, which is separate from the other three. However, it is important to note that eSports also covers activity, management, and fans and media, and therefore could either be distributed among the other three sectors, or considered as a sector separate from SportsTech. Some consider eSports as the mere entertainment corner of the broader video games industry.

Regarding the debate on whether eSports should be considered a sport or not, it is important to note some important differences in terms of the nature and regulations of the two. For as much as technology can be applied to traditional sports, its physical component will always play a fundamental role. On the other hand, eSports is based on a world that is entirely digital and virtual. This virtual world often comes with a storyline that seduces and attracts players and fans. Traditional sports like football and tennis do not work that way, and thus have a different type of audience. Concerning the regulations, it is important to recognise the dependency of eSports and its tournaments on the owners of the video games. While traditional sports competitions are regulated but are not accountable to an owner, eSports tournaments, events and competitions, depend on decisions made by the video game owner. These differences emphasise the need for regulations that are specific to eSports and which do not try to place it within an already existing category.

4. SportsTech ecosystem in Barcelona

Since the Olympics of 1992, Barcelona has become a benchmark for the world of traditional sports and one of the world's sports capitals. Barcelona's international recognition is maintained and reinforced through many other top-level international competitions in several sport disciplines, which the city organises and hosts every year (INDESCAT n/a). The Barcelona City Council manages sporting activity in the capital through sports policy and the Institut Barcelona Esports. The future strategy and vision of the city's sports policy and system is outlined in the Pla Estratègic de l'Esport de Barcelona 2012-2022.

The Plan presents sport as an economic driving force for the city of Barcelona. It proposes boosting entrepreneurship and improving coordination of research into sport, transforming it into economic results in order to consolidate Barcelona's brand and its international positioning (Institut Barcelona Esports 2013). This would be done through a total of 22 strategic projects.

There are several proposed projects with a scope related to the SportsTech and entrepreneurship domains. For instance, the Projecció Internacional de Barcelona aims to increase synergies between sports and other sectors, and to incorporate tools of the digital world into the traditional sports sectors. This would be achieved by improving collaboration between institutions and actors in the city (Institut Barcelona Esports 2013). In addition, the proposed Pla Director TAC-TIC and the Barcelona Mercat Internacional de l'Esport project both focus on the promotion and support of sports-related entrepreneurship and its financing, involving the City Council, universities and research centres, and companies from within the city's sports system.

It is evident that sports entrepreneurship and the integration of technologies in traditional sports, are some of the pillars of the proposed vision for sport in Barcelona. This would create the ideal environment for the development of SportsTech. However, it is important to note that the above-mentioned projects are mere propositions; the Strategic Plan was under review at the beginning of 2019 and the stage of its implementation is not known.

So, what is the situation really like for SportsTech in the city? Do actors in the sports system collaborate to promote its development? Is sports entrepreneurship promoted as much as the plan proposes? Where does Barcelona stand compared to other cities?

4.1. Contextualising Barcelona in Europe

In terms of SportsTech, the Catalan capital is the city with the highest number of SportsTech companies on the Iberian Peninsula (>36%), performing better than its local competitors (Penkert 2017). However, when expanding the perspective to the whole of Europe, Barcelona is not a node in the SportsTech network. Spain is 4th in the top 10 list of countries by number of SportsTech startups, behind the United Kingdom, France, and Germany. While

Barcelona ranks 3rd in the list of cities by number of SportsTech startups, it does not even appear in the top 10 list of cities by funding, which are shown in Figure 4 (Penkert and Malhotra 2019).

Figure 4 - Top 10 European Cities in SportsTech by Funding 2019

This is surprising, given the fact that the city of Barcelona is one of the leading tech hubs in Europe, ranking 3rd in 2019; and it is the best in Southern Europe (Mobile World Capital 2019). In fact, it offers a mix of highly skilled talent, an environment that promotes innovation and a more mature startup ecosystem compared to its competitor, Madrid. The city hosts over 1,300 startups that operate in several fields, mostly in industry 4.0, life sciences and mobile and software technologies (ibid.).

4.2. Startup insights

This section provides an overview of the responses gathered during the interviews with SportsTech startups in Barcelona. Appendix 3 shows the list of interviewed startups organised according to the SportsTech industry framework by SportsTechX.

The interviews revealed overall confusion regarding the perimeter of SportsTech and its internal structure. Some interviewees were uncertain as to whether their startup belonged to this label, following the erroneous but widespread view that SportsTech startups solely operate with digital technologies and use a platform business model. These were often referred to with the term ‘real SportsTech’. Some others associated the term ‘sports’ only with competitive activities. Evidently, despite the strength of the label, the perimeter of the SportsTech industry is still to be clearly defined as it still causes disagreement among actors in the city.

With respect to the SportsTechX framework, it became apparent that sub-sectors have different sizes and levels of development in Barcelona. Sub-sectors using digital platforms seem to be the most popular and developed. This may be due to the support that the city is able to provide to these types of startups, with co-working spaces, hubs and incubators, and a relative ease of access to funding. On the other hand, the Wearables & Equipment sub-sector lags behind, as it seems to face more difficulties. This is because the development of hardware is often much costlier and time consuming, and thus requires higher investment that takes a longer time to be profitable. In addition, hardware developers cannot rely solely on co-working spaces; they also need direct access to the sports world and to manufacturing.

In Barcelona, the sector that seems to be at the earliest stages of its development is eSports. Regulations for the sector are practically non-existent. Teams, promoters, players and ancillary businesses are still self-regulating and building the sector by themselves. The lack of specific social security for eSports professional players calls for new regulations that are specific to eSports and which do not try to place it within an already existing category. In addition, apart from Mediapro – owner of the Liga de Videojuegos Profesional (LVP) – there is a lack of big eSports stakeholders in Barcelona which certainly does not promote its development.
Given the nature of the industry, as well as the lack of actors and support in the city, eSports only needs a high-speed internet connection, therefore teams are not dependent on their geographic location.

On the other hand, all the other interviewees recognised the relevance and importance of Barcelona in terms of a traditional sports ecosystem and its potential in terms of SportsTech. The high number of sports clubs and competitions based in the city, the healthy, sport-oriented lifestyle, the talent pool and the international environment have been mentioned as the top reasons for choosing the Catalan capital as the home of the interviewed startups.

Interestingly, despite the friendly environment that Barcelona provides SportsTech startups, the city still lacks big startup success stories and it does not see significant flows of investment.

4.2.1. Startup challenges

The interviewees highlighted several challenges they encountered, both during the development of their startup and while navigating the city's SportsTech ecosystem.

Lack of incentives to start a business

Interviewees have stressed the fact that they are unable to perceive a difference in regulations for startups and those for consolidated companies, thus emphasising the lack of startup-friendly regulations. The two are treated in the same way in terms of social security and contracting regulations for employees and in terms of taxes. The lack of tax exemptions or discounts in the initial years after setting up a business has been brought up several times, along with the costly bureaucracy. Instead of helping entrepreneurs pay less money, they have to pay to become a freelancer and go through a lengthy process. The costly and lengthy bureaucracy obviously does not help startups develop, as they require an environment that allows them to be agile. For these reasons, interviewees have recognised that Barcelona, and Spain overall, is not the best place to start a business as it focuses on the short-term. Some have mentioned considering moving to other countries and some others, in spite of being native Catalans, have started their company in another country that provided more incentives.

Lack of funds for SportsTech

Getting access to funding has been recognised as the most complicated issue for SportsTech startups. This is because Spanish venture capital (VC) and investment funds have not yet ventured into SportsTech startups, as they are still behind other markets such as the United Kingdom, France and Germany. Consequently, startups rely on investments coming from outside the country. Despite the growth of accelerators and actors providing services and mentorship to local startups, the rate of investment is still lower than what the sector in Barcelona demands. Interviewees have stressed the need to have more actors in the ecosystem and in particular, more investors.

Lack of involvement of sports institutions and federations

A further challenge that the ecosystem is facing, is the lack of involvement of sports clubs, institutions and federations. Startups interviewed have raised this issue both in regard to big players such as FC Barcelona and MotoGP, and to local sports federations. Among the latter group, only a few have representatives involved in SportsTech, and many sports such as sailing, triathlon and skateboarding are lacking initiatives. Interviewees strongly believe that their involvement would help promote the ecosystem. This challenge is also directly linked to a difficulty in accessing facilities where technology can be applied and tested.

Gender imbalance

Originating from the collision of two sectors – sports and technology – that are generally male dominated, this particular challenge to the SportsTech ecosystem should not come as a surprise. The vast majority of SportsTech startups in Barcelona are managed by men. A gender imbalance in SportsTech is also confirmed by the easily noticeable all-male sample of this research study. Despite initiatives in the technology sector in Barcelona, there is a lack of initiatives promoting women's empowerment and involvement, in SportsTech specifically.

4.3. Mapping actors in the SportsTech ecosystem

Technology entrepreneurship seldom succeeds in isolation. Entrepreneurs operate within a network of interconnected organisations and business partners and supporters. The interactions of these actors create an environment that either fosters or hinders entrepreneurial activities (Isabelle 2013; Llados-Masllorens et al. 2008).

An environment can be defined as *entrepreneurial* when it assists and supports the startup process. This can happen thanks to the overall socioeconomic and political context and/or the availability of support services and can be shaped by public policy (Llados-Masllorens et al. 2008). Actors such as incubators and accelerators also act within this environment as a support for entrepreneurs, as a way of accessing a business ecosystem, and as a vehicle for enterprise development (Peters et al. 2004). The presence of these is critical in the promotion of local economic development, as they contribute to creating jobs and to technology and knowledge transfer (OECD 2018).

This section of the report provides a map and a list of main actors involved in the sports and SportsTech ecosystem in Barcelona. Note that this list is not exhaustive and was compiled in July 2019, thus being subject to change. In fact, there are many other actors such as discipline specific federations and clusters – Barcelona Cluster Nautic or Federació Catalana de Basquetbol, for example – that have not been included in the list due to the scope constraints of the report.

Given the importance of the interaction of actors in promoting innovative performance, this report categorises actors in Barcelona according to the triple helix model: government, industry and universities (Leydesdorff and Meyer 2006). Figure 5 shows a map of the actors that are listed and classified in Table 1. Government institutions, programmes and policies related to sport and which are expressly aimed at stimulating entrepreneurship are categorised with the letter G, and are shown on the map with the green pin. Universities and research centres with a direct connection to technology and/or sport are indicated with the letter U and shown with the blue pin. Lastly, industry clusters and firms operating in and contributing to the development of SportsTech are categorised with the letter I, and shown on the map with the red pin. Table 1 also provides further information on the nature, aim and scope of these actors.

Figure 5 - Map of local SportsTech actors - Source: Google Maps

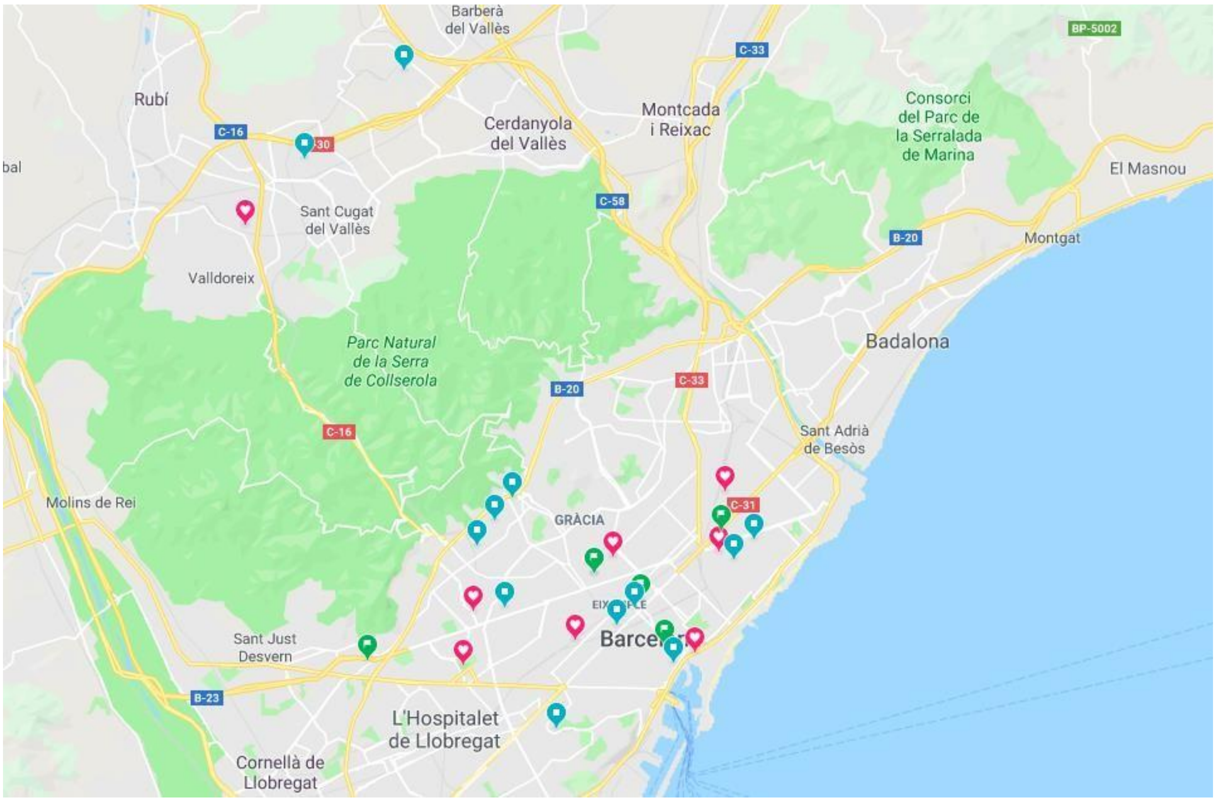


Table 1 - List of local SportsTech actors - Source: own elaboration

Actor	Type	Info	Address and Website
ACCIÓ	G	An agency of the Generalitat de Catalunya focusing on the business competitiveness of Catalan companies to strengthen their capacity in innovation and internationalisation. It provides programmes aimed at startups and access to funding, offering personalised services and programmes to accelerate growth and expand startups. They also offer direct grants – Startup Capital – to recently founded startups.	Passeig de Gràcia, 129, 08008 Barcelona https://www.accio.gencat.cat/
Afydad	I	The Asociación Española de Fabricantes y Distribuidores de Artículos Deportivo is a professional non-profit organisation. It brings together manufacturers, distributors and wholesalers focusing on sports equipment and apparel. It also includes companies applying technology to these areas.	Carrer de Viladomat, 174, 08015 Barcelona http://www.afydad.com
Barcelona Activa	G	Business development agency of the Ajuntament de Barcelona providing startups with numerous services, all with the aim of improving the economic development of the city of Barcelona. It operates as an incubator, offering mentoring, support, training and networking, and it facilitates access to funds.	Carrer de la Llacuna, 162, 08018 Barcelona http://www.barcelonactiva.cat
Barcelona Tech City	I	Private non-profit project driven by local entrepreneurs and supported by the Ajuntament and the Generalitat. It aims to promote Barcelona as an international tech hub. It represents more than 800 businesses and works with	Plaça de Pau Vila, 1 Bloc A, Planta 3, Porta 3A1, 08003 Barcelona https://barcelonatechcity.c

		numerous entities in the city to provide its members with networking and connections to the tech ecosystem and other sector-related activities.	om/
CAR (Centre D'Alt Rendiment Esportiu)	U	This high-performance centre is a sports public body operating under the Secretaria General de l'Esport. It also has an academic centre that allows athletes to continue their studies.	Av. Alcalde Barnils, 3-5, 08174 Sant Cugat del Vallès, Barcelona https://www.car.edu/
Enisa	G	State-owned company operating at state level to provide access to funds for SMEs looking to venture into entrepreneurship projects.	Calle de José Abascal, 4, 28003 Madrid https://www.enisa.es/en
EU Business School	U	BA in Sports Management MBA in Sports Management	Avinguda Diagonal, 648B, 08017 Barcelona https://barcelona.euruni.edu/
Eurecat Centre Tecnològic	U	Main technology centre of Catalonia. It is involved in the implementation of Catalonia's technological strategy. It operates as a bridge between research and knowledge and their economic applications.	Carrer de Bilbao, 72, 08005 Barcelona https://eurecat.org/
FC Barcelona (Barça Innovation Hub)	I	The world-renowned football club created the Barça Innovation Hub, a sports innovation and knowledge centre aimed at promoting scientific research projects and improving the future of sports through the application of technology.	C. d'Arístides Maillol, s/n, 08028 Barcelona https://barcainnovationhub.com/
Fundació Catalana per a l'Esport	I	Private non-profit entity of public interest contributing to the promotion of Catalan sports.	Rambla de Guipúscoa 23-25 1r, B, 08018 Barcelona http://fcesport.cat/
Geneva Business School	U	BBA with a Major in Sports Management MBA with a Major in Sports Management	Gran Via de les Corts Catalanes, 617, 08007 Barcelona https://gbsge.com/bba-sport-management/
ICF (Institut Català de Finances)	G	Public institution operating under the Government of Catalonia. It aims to provide support to Catalan companies and entrepreneurs through facilitating access to funding.	Gran Via de les Corts Catalanes, 635, 08010 Barcelona http://www.icf.cat/
INDESCAT	I	The Catalan sports industry cluster is a private non-profit organisation bringing together companies and organisations operating in the sports ecosystem. It provides support services to sports entrepreneurs through the INDESUP! programme.	Milà i Fontanals, 14-26 1r, 6a, 08012 Barcelona https://indescat.org/
INEFC (institut Nacional d'Educació Física de Catalunya)	U	Degree in Physical Activity and Sports Science (CAFE) (with Universitat de Barcelona or Universitat de Lleida) Professional Master in High Performance in Team Sports (in partnership with FC Barcelona) Professional Master in Football (in partnership with FC Barcelona) Interuniversity Master's Degree in Sports Technology (in collaboration with Universitat de Vic) etc.	Avinguda de l'Estadi, 14, 08038 Barcelona http://inefc.gencat.cat/

Instituts Barcelona Esports	G	Operating under the Ajuntament de Barcelona, this institute overlooks sports policy and system in the city.	Plaça de Sant Jaume, 1, 08002 Barcelona https://ajuntament.barcelona.cat/esports/ca
ISDE Law Business School	U	Global Master in Sports Management and Legal Skills (in partnership with FC Barcelona) Master in eSports Business (in partnership with DreamHack)	Av. del Tibidabo, 30, 08022 Barcelona https://isde.es/en/
Johan Cruyff Institute	U	Master in Football Business (in partnership with FC Barcelona) Master in Sport Management Postgraduate Diploma in Sport Management Postgraduate Diploma in Sport Marketing	Carrer de Pomaret, 8, 08017 Barcelona http://johancruyffinstitute.com/en/sport-management/
La Salle Ramon Llull University	U	Graduate in Management of Business & Technology with specialisation in Sports Management	Carrer de Sant Joan de la Salle, 42, 08022 Barcelona https://www.salleurl.edu/en/education/degree-management-business-and-technology
Land Sport Law	I	This firm provides legal and advisory services to companies operating in all areas of the sports industry. It also operates as consultants for eSports gamers, teams, sponsors and broadcasters.	Plaça Ausiàs March 1 Planta 2, despatx 10, 08195 Sant Cugat del Vallès, Barcelona https://landsportlaw.com/en/
Leitat Technological Center	U	This non-profit centre of technological innovation develops R&D in several areas and transfers and applies its technologies to industries such as sports.	Carrer Innovació, 2, 08225 Terrassa, Barcelona https://www.leitat.org
N3XT Sports	I	Sports Technology and Innovation consultancy firm recently established in Barcelona.	Carrer de Tànger, 86, 08018 Barcelona https://www.n3xtsports.com/
Secretaria General de l'Esport de la Generalitat de Catalunya	G	Planning and execution organ of the sports administration of the Government of Catalonia. It has numerous autonomous bodies, such as the INEFC.	Av. dels Països Catalans, 40-48, 08950 Esplugues de Llobregat, Barcelona http://esport.gencat.cat/ca/inici/
Tenkan-Ten by ASICS	I	Startup growth catalyst focused on the Sports and Well-being sector. It runs an annual programme for 5 selected startups with innovative ideas and a mentality that fits in with ASICS.	Carrer del Dr. Ferran, 25, 08034 Barcelona https://tenkan-ten.com/
Universitat Autònoma de Barcelona	U	Master in Sport Management	Campus de la UAB, Plaça Cívica, 08193 Bellaterra, Barcelona https://www.uab.cat/web/estudiar/official-master-s-degrees/general-information/sport-management-1096480962610.html?param1=1345696886751

Universitat de Barcelona	U	Master in Sports Business Management Master in Management and Administration of Sports Organisations Degree in Physical Activity and Sports Science (CAFE) - (with INEFC)	Gran Via de les Corts Catalanes, 585, 08007 Barcelona https://www.ub.edu/web/ub/en/estudis/oferta_formativa/master_universitari/fitxa/S/M0S0C/index.html
Universitat Pompeu Fabra	U	Master in Sports Management	Plaça de la Mercè, 10, 08002 Barcelona https://www.bsm.upf.edu/en/master-in-sports-management-and-direction/study-plan

4.4. Analysis of the ecosystem

The actors listed above shape and promote the SportsTech ecosystem in Barcelona through initiatives and interactions. This section provides an overview of the ecosystem, its initiatives and interactions between actors which were gathered during the interviews.

4.4.1. Government actors

From the list above it is evident that some of the main actors involved in the sports and SportsTech ecosystem in Barcelona are both private and public stakeholders. This ecosystem, made up of universities and research centres with specific programmes in sports and/or technology, public and private incubator and accelerator programmes, and institutions providing access to funds, has the potential to support the development of SportsTech (European Commission 2017).

A key aspect of this entrepreneurial ecosystem is the presence of public programmes such as Barcelona Activa and ACCIÓ, which provide services to support entrepreneurship, such as access to a co-working space, mentoring, training, career services, acceleration and incubation programmes for startups. These tools for economic development operate under the Ajuntament de Barcelona and the Generalitat de Catalunya, respectively, and are complemented by private incubators and accelerators. Some examples of these are: Conector, Seedrocket, Wayra, and LaSalle Technova. The latter is directly linked to La Salle Ramon Llull University. In addition, the private non-profit Barcelona Tech City offers its members services such as networking and connections to the tech ecosystem, sector-related activities and conferences, with the aim of positioning Barcelona as a world-renowned tech hub. While focusing on technology and entrepreneurship, and thus still supporting and promoting the SportsTech ecosystem, none of these public sector-driven programmes has a narrow focus on any specific sector. Despite the strategic objectives set by the Pla Estratègic de l'Esport de Barcelona 2012-2022, no public sector project or initiative to promote entrepreneurship within the SportsTech industry currently exists.

Similarly, regarding access to funding, no SportsTech-specific VC funds yet exist in Barcelona. From the public side, financial support is often accessed through public financial institutions such as the Institut Català de Finances, or Enisa; as well as Catalonia-based private VC Funds – e.g. Caixa Capital Risc, Sabadell Venture Capital, Inveready, Nekko Capital among many others – and Business Angels groups – e.g. ESADE BAN, IESE BAN, etc. However, neither of these are specific to the SportsTech industry, or have a history of investing in it.

4.4.2. Industry actors

An important actor in promoting entrepreneurship within the sports ecosystem is the Catalan sports industry cluster, INDESCAT. With the goal of improving competitiveness in Catalan sports companies, the activities of the cluster focus on three main topics: innovation, internationalisation and talent. Among its initiatives, the sports cluster is responsible for the entrepreneurship programme INDESUP!. Currently in its third edition, the programme aims to support the consolidation of new companies in any sports-related field, and it does so by providing networking possibilities, training and mentoring, and by facilitating access to funding and investment. The programme recently opened up to international startups as well as local ones. INDESUP! also organises several activities to promote the visibility of sport startups, such as the Sports Entrepreneurship Day, the SportMatchmaking event to create synergies between startups and consolidated companies, Business and Sports prizes and awards, and the SportsPitch. The latter involves final year Sports Management students, and successfully promotes and creates interaction and synergies between the Industry and University categories of the triple helix model. Among the many activities organised by INDESUP!, particularly relevant is INDESUP! Tech, which provides training activities based on technology and entrepreneurship skills.

Interestingly, the INDESUP! programme and its activities are supported by the Government of Catalonia, and organised thanks to the support of the Universitat de Barcelona – and its professors from the relevant disciplines – and Eurecat. This programme clearly represents an example of the triple helix model, as it successfully creates interactions between the three categories. Nonetheless, despite it having a successful participation rate – with around 150 startups having participated in its activities so far – and it providing a tech-focused training programme, it is important to note that the scope of the programme and the INDESCAT cluster are not specific to tech companies, rather they are broader and integrate the entire sports industry.

From the Industry side, the presence of big actors such as FC Barcelona and its initiatives is seen as beneficial for the city as it attracts talent. The strategic project, Barça Innovation Hub, employs an open innovation strategy and promotes collaboration with universities and research centres, and other sports entities. The Hub also organises the annual Barça Sports Technology Symposium, now in its 5th edition, which is open for registration and has a fee of €499, which is relatively high and often unaffordable for small entrepreneurs. FC Barcelona also partners with universities and institutes in the city, such as the INEFC, ISDE and

Johan Cruyff Institute, to offer academic courses. Nonetheless, interviewees recognised that despite the vertical specialisation and the focus on technology and innovation, given the private nature of the company and its internal and international orientation, it does not seem to contribute as much to the local SportsTech startup ecosystem.

Similarly, the presence of the startup accelerator programme, Tenkan-Ten by ASICS, puts Barcelona on the global map of Sports – and SportsTech – specific programmes, but its international orientation does not contribute much to the local ecosystem. Indeed, looking at the list of participating startups, out of the five of them, not a single one is based in Barcelona, and only one is based in Spain.

It is evident that the SportsTech scene in Barcelona is lacking initiatives in the traditional sporting disciplines in which it prospers, such as triathlon, sailing, swimming, skateboarding and many more.

The presence of private actors such as the consultancy firm N3XT Sports, with its organisation of sector-related events, and the law firm Land Sports Law, with its services for sports and eSports, contribute to the development of the ecosystem from the Industry side.

4.4.3. University actors

The University category clearly shows that the city's research and teaching orientation reflects the importance of the sports industry (Nelson 1992). However, out of all the programmes listed in the table, only two focus on the integration between sports business and technology: the *Management of Business & Technology programme with specialisation in Sports Management* at La Salle Ramon Llull University, and the *Interuniversity Master's Degree in Sports Technology* at INEFC. The latter is given in collaboration with the engineering faculty of the Universitat de Vic and will run its first edition in the academic year 2019/2020.

This new interdisciplinary programme is designed for engineering graduates and physical education graduates and it exemplifies the increase in the number of university programmes which focus on the intersection between sports and technology, reflecting the increase in momentum of SportsTech in the city. It also compensates for the lack of integration between faculties that is typical of the local university system.

Universities are attempting to create synergies by inviting entrepreneurs and companies to showcase their projects and technology applications, and by organising and promoting SportsTech events, initiatives and competitions. For instance, LaSalle Ramon Llull University organises the international startup competition Euroleague Basketball Tech Challenge, and IDSE organised a bootcamp for HYPE SPIN ACCELERATOR for Blockchain Applications in Sports and eSports in collaboration with the Israel-based HYPE Sports Innovation.

Despite the increasing number of relevant programmes and initiatives, there is an overall problem of communication and connection between University and Industry, caused by the relatively low level of skilled human capital, especially in terms of digital skills, and by an insufficient transfer of knowledge from universities and research centres to businesses (European Commission 2017).

5. An example of best practice

As already mentioned, Barcelona is not part of the top 10 SportsTech cities by funding (Penkert and Malhotra 2019). The three cities which occupy the top 3 positions in all rankings are London, Paris and Berlin. This section looks into Paris and its initiative, Le Tremplin, as a role model and example of best practice.

Le Tremplin is an innovation platform for sports-related startups. One of the main sponsors of this private non-profit is Paris&Co, the economic and innovation development agency of the City of Paris. The involvement of public actors such as the City of Paris and the Ministry of Sports in cooperation with private actors, ensures their cooperation towards a common goal and maintains a balance between local and international startups. Le Tremplin provides an equity-free incubation programme that accompanies startups for a period of 1 to 3 years. An incubation period which is longer than most programmes makes this programme successful, and a lack of commercial interest makes sure conflicts of interest between actors are avoided (Penkert 2019b). Le Tremplin overcame the challenge of integrating several diverse actors into one place. It creates synergies between over 60 startups and 30 institutional and corporate partners (Penkert 2018).

When using a comparative perspective, interviewees have highlighted the triple helix model of innovation embodied by Le Tremplin, stressing the lack of connection between startups and universities, research centres and consolidated companies in Barcelona.

6. Concluding remarks

The SportsTech industry is still in its early stages of emergence. It is witnessing an increase in specialised programmes and hubs at European and global levels, but there are still few dedicated investment funds.

Compared to the rest of the Iberian Peninsula, Barcelona has become an important SportsTech hub. However, it is falling behind its European competitors. Given the fact that it is home to many sports companies, federations and clubs, the city has the potential to become a strong, well-positioned node in the SportsTech network, but it is currently missing out. It is attracting SportsTech startups based on its internationally renowned reputation in traditional sports, but it is lacking the initiatives to push the development of the industry forward and promote its growth.

The depth and diversity of challenges that SportsTech (and also non-SportsTech) startups are facing are signs of an entrepreneurial ecosystem that is still maturing. A necessary condition for improvement is for the public sector to act as an ally rather than an obstacle (Mobile World Capital 2019).

The city of Barcelona is home to several actors and initiatives that are the perfect ingredients for achieving excellence in SportsTech; however, they seem to proceed in a parallel fashion, with sporadic but increasing interactions. This is likely due to a lack of coordination and a lack of a vertical specialisation in SportsTech.

From the interviews it is evident that SportsTech entrepreneurs encounter difficulties navigating the rich and complex ecosystem. The general instruments of support, namely Barcelona Activa and ACCIÓ, are helpful and the efforts of INDESUP! are remarkable; however, the lack of a SportsTech-specific initiative is apparent. As previously mentioned, the few vertically specialised actors and initiatives are Barça Innovation Hub and Tenkan-Ten which, given their private nature, focus on corporate purposes that do not provide direct benefits to the local ecosystem.

The absence of industry-specific public sector involvement or private-public initiatives might hinder the development of the local sector. In fact, most of the Barcelona-based private SportsTech initiatives and competitions are open internationally. This results in an increase in global competition, which helps increase the efficiency of local startups thanks to the transfer of knowledge, but without the presence of an actor to maintain a balance between local and global, this transfer might not occur. In the case of INDESUP!, the Catalan sports cluster makes sure this balance is maintained by spreading the benefits to all members, but this does not happen in the other cases. The need for the ecosystem to have an actor that is properly able to integrate all different actors in order to create and strengthen the local ecosystem, has been mentioned several times by the interviewees.

Compared to other cities, Barcelona is behind in terms of interactions between universities, research centres and consolidated companies with startup companies. This represents a missed opportunity for the overall SportsTech ecosystem. Individual initiatives need to join forces to create a network of effective relationships (European Commission 2017). This collective action and community-building is deemed fundamental for the creation of synergies and the generation of momentum for the growth of the emerging industry. The convergence of actions of entrepreneurs and associated actors occurs in the co-evolutionary stage of industry emergence (Gustafsson et al. 2016). Therefore it appears that the SportsTech industry in Barcelona is currently at this stage of development, characterised by an increasing number of collaborative strategic actions and the establishment of alliance networks.

6.1. Recommendations

Vertical specialisation

The presence of a vertically specialised actor would contribute to the development of the local SportsTech ecosystem. This actor would provide support, acceleration and incubation services to SportsTech startups. Matching the entrepreneurs' needs with the actor's mission, purpose and sector focus would improve the efficiency of the ecosystem (Isabelle 2013). It would also generate greater value for participating firms and facilitate the navigation of the ecosystem, as opposed to other mixed-use accelerators and incubators whose scope spans a variety of industries (Perdomo et al. 2014). The services of this specialised actor should be open year-round and available at a subsidised rate that is accessible to all the entrepreneurs involved in the ecosystem, regardless of the stage of growth of their startup.

Create economies of synergy

The main aim of this actor should be to address gaps in collaboration, by fostering close interactions and the creation of a shared vision among the actors in the ecosystem. It should promote active involvement and knowledge and technology transfer between universities and research centres, startups and consolidated companies, and public institutions. Increasing interactions and collaborative activities would contribute to creating momentum for the industry, thus making it more attractive for investment. In addition, the physical concentration of actors would create spatial economies of synergy and increase the possibility of value-added creation (Castells 2010).

Public sector involvement

The involvement and support of the public sector is of fundamental importance to the success of this initiative, as it would ensure a balance in the running of its activities and it would safeguard against conflicts of interest. The city of Barcelona has already showcased its ability to bring actors from different spheres of the sports ecosystem together to work towards a common goal, with the Olympics in 1992. This SportsTech-specific actor should aim to do the same.

In addition, the involvement of the public sector has the potential to tackle social issues relative to the sector, such as gender imbalance, and to execute projects and achieve the goals outlined in the Pla Estratègic de l'Esport de Barcelona 2012-2022.

Improve University-Industry links

The actor should facilitate cooperation and transfer of knowledge between local universities and research centres, businesses and sports organisations. This would foster entrepreneurship and promote digital competences in sports-oriented courses, thereby improving Industry-University interactions and promote the commercialisation of university research and student projects.

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Appendix 1: Interview questions

Briefly introduce your startup/organisation.

What sector does your organisation belong to? What sub-sector?

How has the Sports sector changed over the past decade?

What is the state of development of SportsTech?

How do you see it developing in the future?

Why did you choose Barcelona for your SportsTech startup?

Why not other cities like London, Paris, or Berlin?

What is the state of development of the sector in Barcelona?

What is your organisation doing to contribute to the development of the sector?

What are other actors doing to contribute to the development of the sector?

How are their interactions affecting its development?

How do you see the startup ecosystem in Barcelona helping or hindering the development of the SportsTech sector?

What are the main challenges you encountered in the sector in Barcelona?

How could Barcelona improve in terms of public policies, startup support, and sector development?

Appendix 2: List of interviewees

Organisation Name	Interviewee	Position
NX Swim	Kay Eckl	Founder and CEO
Metrica Sport	Rubén Saavedra Pascual	Founder and CEO
Coach Studio	Sergi Corteés	CEO
Soccer Dream	Andreu Bartolí	CEO
3D Digital Venue	Francis Casado	Head of International Business Development
Gymforless	Oriol Vinzia	CEO
Fan360	Matheus Provinciali	Founder and CIO
SoCourt	Albert Marco Gómez	CEO
Sportium	Joan Agut	COO
OrigenBCN*	Victor Casanovas	Director
INDESCAT	Alex Rivera	Director
INDESCAT (INDESUP!)	Xavier Faura	Innovation & Entrepreneurship Manager
SportsTechX	Benjamin Penkert	Founder
INEFC	Jordi Solà	Director

Appendix 3: Startups according to SportsTechX framework

<table>
<tr><th>Sector</th><th>Sub-sector</th><th>Startup</th></tr>
<tr><td rowspan="3">Activity & Performance</td><td>Wearables & Equipment</td><td>NX Swim</td></tr>
<tr><td>Activity Data & Analytics</td><td>Metrica Sport</td></tr>
<tr><td>Coaching & Preparation</td><td>Coach Studio
Soccer Dream</td></tr>
<tr><td rowspan="2">Management & Discovery</td><td>Organisation</td><td>3D Digital Venue</td></tr>
<tr><td>Marketplaces</td><td>Gymforless</td></tr>
<tr><td rowspan="4">Fans & Media</td><td>News & Content</td><td rowspan="2">Fan360</td></tr>
<tr><td rowspan="2">Fan Engagement & Social Platforms</td></tr>
<tr><td>SoCourt</td></tr>
<tr><td>Fantasy Sports & Betting</td><td>Sportium</td></tr>
<tr><td>eSports</td><td>eSports</td><td>OrigenBCN*</td></tr>
<tr><td colspan="3">*not a startup but an eSports team</td></tr>
</table>