STRN Sports Tech Research Network

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The Current State of Innovation in Sports Tech: Pathways Toward Sustainable Ecosystems

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Executive Summary

The Challenge: Fragmentation in a High-Growth Industry

The sports technology sector is rapidly expanding, driven by Industry 5.0, AI, and human performance science. However, the ecosystem remains critically fragmented. Innovation pathways operate in isolated silos — **Academic** (rigor-focused), **Elite Sport** (performance-focused), and **Commercial** (velocity-focused) — creating a "Valley of Death" where promising technologies fail to reach scalability or market validity.

The Framework: A Whole-System Approach

This white paper adapts the MIT Innovation Ecosystem Framework to the unique context of sports technology to propose a cohesive model for sustainable growth. We identify:

- **The Stakeholders (The Who):** Five key actors (Entrepreneurs, Risk Capital, Corporates, Government, and Higher Education Institutions) who must move beyond transactional relationships to deep collaboration.

- **The Drivers (The How):** Six essential capacities that must be actively cultivated: Human Capital, Funding, Infrastructure, Demand, Culture, and a newly identified sixth pillar, Leadership & Vision.

- **Cross-Industry Synergies (The What):** Areas where strategic collaboration with adjacent sectors such as healthcare, wellness, tactical / military and occupational health offer dual-use pathways for validation, funding, and scale.

The Path Forward

To transition from volatile hype cycles to a resilient ecosystem, the industry must:

- **Bridge the Silos:** Empower universities to act as neutral ecosystem orchestrators and use elite sport as a validation testbed.

- **De-Risk Innovation:** Adopt "blended finance" models that pair public grants with private capital to survive early-stage development.

- **Expand Horizons:** Pursue "dual-use" strategies that leverage synergies with adjacent industries like healthcare, defense, and occupational safety to ensure long-term sustainability.

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I. Introduction

Innovation in sports tech is rapidly evolving, driven by the convergence of new **software** and **hardware capabilities**, rapidly expanding **human performance science**, and the growing demand for **personalized**, **data-driven solutions**. This sector holds significant value potential, yet it faces a critical challenge: the accelerated pace of **product innovation** has dramatically outpaced the growth of **mature infrastructure**, **quality assurance standards**, **cohesive frameworks**, and **synergistic partnerships**. This gap limits the industry's capacity to sustain long-term stability through innovation and leaves it susceptible to inefficiencies, volatility, and strategic blind spots. These issues highlight the need for strategic foresight, comprehensive system development, formal validation efforts, and cross-industry learning to **sustain innovation while minimizing volatility**.

In this context, innovation is best understood as the process of transforming novel ideas, whether technological, behavioral, or organizational, into real-world solutions that improve athletic performance, enhance well-being, and promote healthier lifestyles across diverse populations. While recent insights recognize the potential role technology may play in athlete health and performance (Rebelo et al., 2023; Tan et al., 2023), the **lack of effective innovation ecosystems** has led to fragmented solutions and limited cross-sector diffusion, preventing technology from fully addressing **user** and **market needs**.

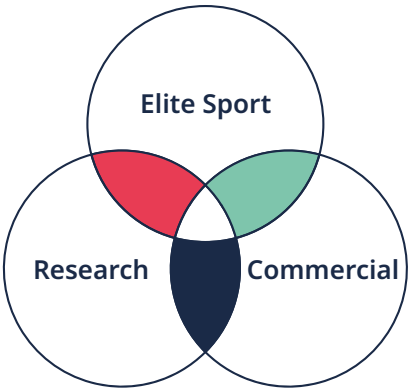
While **innovation** is widely understood in definition, its **practical role** is to systemically de-risk and optimize uncertain outcomes. Challenges arise because this process is fractured by divergent operational priorities. For instance, in **Academia**, innovation may refer to significant and novel insights found through rigorous processes contributing to greater scientific knowledge. Operationally, optimal outputs of innovation within academia include the published manuscripts themselves, impact factors, and grant funding awards. In **Elite Sport**, the focus is on solutions that provide a competitive edge, prioritizing implementation and immediate performance impact. While innovation in elite sport is not exclusively technologically driven, technological advancements are increasingly driving innovation efforts across clubs, federations, and leagues around the world. Conversely, for **Startups**, innovation includes not only market differentiation, but the identification of product-market fit and achieving scale, meaning the process is driven by market velocity. When stakeholders fail to clearly articulate and align the specific output their innovation initiatives will de-risk and optimize, they cannot effectively guide their own efforts or collaborate with others. This misalignment creates fundamental structural barriers that lead directly to ecosystem fragmentation.

The costs of this fragmentation are significant. Stakeholders — including entrepreneurs, sport organizations, investors, policy-makers, and researchers — face rapid **technological obsolescence**, critical **interoperability issues**, and **inconsistent product quality**. The lack of effective innovation ecosystems, integration frameworks, and industry-wide collaboration has resulted in **fragmented solutions**, **inconsistent adoption rates**, and inefficiencies that **hinder sustainable growth**.

This environment leads to wasted investment, "tool creep," sunk cost mistakes, data without insight and the risk of deploying unvalidated technologies (Windt et al., 2020, Robertson et al, 2023). Evidence from elite sport highlights the need for "**guardrails**" to manage rapid technology introduction, including clear validation, data governance, and athlete-centered implementation pathways (Ash et al., 2022, West et al, 2024). While consensus guidance exists to standardize the validation for sport wearables; adoption remains uneven (Doherty et al., 2024; Robertson et al., 2023).

Open innovation ecosystem scholarship conceptualizes innovation as a **coordinated, multi-actor system involving government, universities, corporates, start-ups, investors, intermediaries, and users** (Canini et al., 2026). Despite sport's structural similarity to these models, ecosystem-based analyses remain limited within sport contexts. This gap reinforces the need for structured frameworks tailored to sport technology, where fragmentation stems from misaligned incentives and weak coordination across actors.

This paper provides a global overview of the current sports technology landscape, examining the **distinct innovation pathways of Academic** (higher education institutions, **Research** institutes), **Elite Sport** (professional sport organizations, federations), and **Commercial** (business, for-profit) **ecosystems**. Our objective is to analyze the roles of **key stakeholders and drivers**, and to identify **strategic synergies with adjacent industries**. By examining foundational pillars from a broader innovation perspective, we aim to identify existing gaps and opportunities for structured, scalable growth. Our analysis emphasizes the importance of collaborative efforts in shaping the development pathways of sports technologies to ensure they are designed with end-users' needs in mind and enhance feasibility and long-term viability.



The through-line is simple: with **strategic frameworks** and **cross-industry collaboration**, the sports tech industry can transition from fragmented, high-risk innovation cycles to a more **integrated**, **sustainable**, and **impactful ecosystem** for athletes, individuals, and teams worldwide.

II. Global View of Innovation within Sports Tech

While the Academic, Elite Sport, and Commercial ecosystems each drive innovation within their respective domains, the current state of sports tech is largely defined by their **lack of structured interaction**. Ecosystem research emphasizes that innovation depends on differentiated but interdependent actors performing complementary roles (Canini et al., 2026). Sport technology reflects this same multi-actor architecture; however, without deliberate alignment mechanisms, these actors often operate in **parallel** rather than as an **integrated system**, reinforcing **structural fragmentation**. This fragmentation is a primary bottleneck to sustainable growth, as the distinct drivers, timelines, and success metrics of each pathway often create friction rather than synergy.

Academic spinoffs, driven by research rigor and accuracy, produce cutting-edge innovations but often struggle with product form, market readiness, and accessing the necessary funding to cross the "**valley of death**" between prototype and implementation. **Elite Sport environments** provide deep insights into the problems, application, and use cases but lack the skills needed to create a **technological solution**. While elite sport provides a highly valuable environment for problem discovery and early-stage validation, most sport organizations do not position themselves as primary builders of commercially scalable technology. Instead, innovation increasingly occurs through **partnership-led models**, such as club- or federation-affiliated innovation labs and hubs that collaborate with startups, universities, and external vendors to develop and test solutions in applied settings. At the same time, many teams and federations continue to **develop internal tools**, such as dashboards, algorithms, or bespoke workflows, driven by proximity to the problem, a desire for control, perceived efficiency gains, or potential monetization and often shaped by available internal skills rather than clearly defined product or market requirements. These internally built solutions are frequently effective for **local decision-making** but are rarely designed with scale, product maturity, or commercialization in mind. As a result, innovations validated in elite sport settings often struggle to **translate beyond their original context** unless supported by deliberate product strategy, technical and business expertise, and alignment with broader market needs. Conversely, the **commercial ecosystem**, characterized by a "move fast" ethos, prioritizes innovation velocity and market capture. This can lead to pressures that **bypass rigorous validation** and deep (problem-solution) **contextual understanding**, resulting in a market where hype often outpaces reality.

Dimension	Academic	Elite Sport	Commercial
Problem & Use Case Understanding	🟡🟡⚪	🟢🟢🟢	🔴⚪⚪
Technical Expertise (Domain)	🟡🟡⚪	🟢🟢🟢	🔴⚪⚪
Technical Expertise (e.g. STEM)	🟢🟢🟢	🔴⚪⚪	🟢🟢🟢
Innovation Velocity	🔴⚪⚪	🟡🟡⚪	🟢🟢🟢
Product & Market Readiness	🔴⚪⚪	🔴⚪⚪	🟢🟢🟢
Commercial Strategy & Business Acumen	🔴⚪⚪	🔴⚪⚪	🟢🟢🟢

🔴⚪⚪ = Low 🟡🟡⚪ = Moderate 🟢🟢🟢 = High

Table 1: Innovation Ecosystem Comparison
This table compares the three primary innovation pathways in sports technology: Academic Spinoffs, Elite Sport, and Commercial ventures. Each ecosystem exhibits distinct strengths (research expertise, use-case depth, market agility) and characteristic challenges (funding access, validation pressures, hype-versus-reality gaps). Understanding these differences enables stakeholders to identify collaboration opportunities and address systemic weaknesses through targeted partnerships. Future research should empirically validate these ecosystem dynamics and refine coordination mechanisms for long-term sustainability.

Definitions:

- **Problem & Use Case Understanding:** Accuracy and depth of identifying real-world problems, user needs, workflows, and applied use cases.
- **Technical Expertise (Domain):** Depth of scientific and domain-specific knowledge relevant to sport and human performance perspective (not engineering execution).
- **Technical Expertise (STEM):** Proficiency in applied science, technology, engineering, and math, including software, hardware, data systems, and system integration (not product strategy).
- **Innovation Velocity:** Speed and flexibility with which ideas move from concept to prototype to iteration.
- **Product & Market Readiness:** Degree to which solutions are usable, deployable, supported, and scalable beyond a single controlled environment.
- **Commercial Strategy & Business Acumen:** Understanding of business models, pricing, distribution, customer acquisition, and long-term sustainability

Successfully navigating this landscape requires **frameworks** that can bridge these silos, aligning the **rigor** of **Academia**, the **contextual understanding** and **application depth** of **Elite Sport**, and the **technical expertise** and **scaling capacity** of the **Commercial sector**. Sports technology innovation is not confined to a single domain or development pathway — it thrives within a globally interconnected ecosystem shaped by academic institutions, (elite) sport organi-

zations, and commercial enterprises. Each sector contributes distinct yet interdependent mechanisms that drive world-class innovation, from foundational research and prototype development to real-world validation and mass-market adoption. At the **global level**, this landscape is shaped by **regional policies**, **institutional incentives**, and **funding structures** that influence the pace and direction of progress. Whether emerging from university labs, publicly-funded research and development projects, or venture-backed startups, sports tech innovations increasingly rely on collaborative ecosystems that fuse scientific rigor with entrepreneurial execution. Understanding the unique roles and interactions of these ecosystems is essential to navigating and accelerating the global trajectory of sports technology

Academic Spinoff Ecosystem

Academic spinoffs represent a central mechanism by which Higher Education Institutions (HEI) contribute to sports tech innovation. At its core are processes such as disruptive thinking, knowledge valorization, technology transfer, and spin-off creation, each serving as a bridge between scientific research and commercial applications. In sports technology, where product cycles are fast and user needs are highly specific, the **role of academic spin-offs** becomes particularly vital in **transforming scientific findings into usable and scalable innovations, with meaningful real-world impact**.

The Entrepreneurial Academic Foundation

The foundation of this ecosystem rests on an **entrepreneurial mindset** that is oriented toward recognizing opportunities, achieving societal impact, and taking calculated risks. Unlike purely commercial ventures, Miller et al. (2018) identify entrepreneurial academics as motivated not solely by financial returns but by **desires to see their research create tangible societal impact**, particularly relevant in sports technology, where innovations can enhance public health, athlete health, and inclusive physical activity.

Research by Fini et al. (2021) demonstrates that **academic engagement in entrepreneurial activities** enhances both **innovation output** and the **quality of scientific research** itself. Programs like imec's 101 Programme exemplify how targeted mentorship, cross-disciplinary collaboration, and real-world validation can significantly improve both impact and scalability of spin-off ventures (Schuurman et al., 2017).

Technology Transfer Evolution

Traditional linear technology transfer models face criticism for being **disconnected from market needs**. De Wit-de Vries et al. (2019) and Hamilton and Philbin (2020) advocate for integrated, iterative approaches incorporating **market analysis**, **stakeholder input**, and **adaptive development**. In sports tech, where end-user adoption is crucial, this "**flipped TTO**" model (i.e., flipped knowledge transfer model) prioritizes user and market input early in R&D processes, significantly reducing time-to-

impact. Under this rationale, **Technology Transfer Offices**, within Higher Education Institutions (HEI) act as **facilitators** by proactively creating, hands-on, collaborative environments where entrepreneurs and end users are challenged to validate business ideas emerging from established research programs.

Still, barriers remain. Many research groups lack **resources** for extensive commercialization, and the **skills** for business development while institutional incentives often prioritize academic output over societal impact. Solutions include **valorization sabbaticals** and **dual-career pathways** that allow researchers to engage in business development without sacrificing academic rigor.

Sports Tech Spin-off Success Factors

Mathisen and Rasmussen (2019) emphasize that academic spin-offs thrive through continued academic involvement, dedicated ecosystem support, and alignment between technological capacity and market demand. In **sport innovation**, **success factors** include early market feedback exposure, real-life user engagement, and interdisciplinary team building — practices not yet institutionalized across most academic settings (Reichert, 2019). **Embedding entrepreneurial training in research curricula** and **expanding startup support programs** can help scale promising ideas beyond academic boundaries, vital given sports tech's niche markets, where specialized innovations often struggle to find early commercial support.

Elite Sport Innovation Ecosystem

The elite sport innovation ecosystem operates at the highest level of athletic competition, where marginal gains can determine the difference between podium finishes and near misses. This ecosystem is uniquely characterized by its significant financial investment originating from **professional clubs and franchises, national governing bodies, Olympic and high-performance sport programs, commercial sponsorships, and, in some cases, public sport funding structures**. It also benefits from access to elite athlete populations for applied testing and close collaboration among multidisciplinary teams, including coaches, sport scientists, medical staff, performance analysts, and technologists.

While technological innovation is an increasingly important driving force in elite sports, the successful implementation of these technologies depends heavily on the **expertise of coaches and sport scientists** (Buttfield

& Polglaze, 2016). The role of technology in sports is evolving, with innovations ranging from incremental improvements to radical shifts in how sports integrate technology (Ratten, 2018). Unlike commercial ecosystems that prioritize mass-market scalability within the general population, elite sport innovation is performance-driven and tightly coupled with high-stakes, real-time applications.

A Global Network of Innovation Hubs

In recent years, **specialized innovation hubs within teams, leagues and governing bodies** have become increasingly visible components of the elite sport ecosystem, supporting the development and application of new technologies. As sports technology investment grows, many first-generation sport accelerators have either scaled back or shifted away from traditional cohort-based formats, often reflecting constraints in financial or institutional support. In contrast, a **second wave of corporate- and federation-embedded innovation platforms** has taken shape, offering structured pathways for piloting, deployment, and strategic alignment with existing sport infrastructure.

At the **global level**, the **FIFA Innovation Programme** serves as a centralized mechanism for sourcing and trialing emerging technologies within live tournament environments, focusing on areas such as fan engagement, sustainability, artificial intelligence, and officiating tools.

In **North America**, the **NBA Launchpad** operates as a league-run initiative that selects startups for structured pilot collaborations aligned with strategic league priorities, including player health, youth development, and fan engagement. Rather than functioning as a traditional accelerator, the program embeds companies within league operations through defined R&D projects that culminate in structured demonstration opportunities. Similarly, the Comcast NBCUniversal SportsTech accelerator integrates early-stage ventures directly into a consortium of media and sport partners, including NBC Sports, the Premier League, NASCAR, and the PGA Tour, providing capital, mentorship, and structured pilot pathways within commercial infrastructure.

In **Europe**, sport innovation is increasingly organized within federation- and league-embedded platforms. The **UEFA Innovation Hub** operates as a strategic interface between startups, corporates, and European football governance, focusing on areas such as sustainability, competition operations, and fan experience. Germany's **DFL Deutsche Fußball Liga Innovation Hub** similarly integrates technology partnerships within Bundesliga media production and digital strategy. At the club level, **FC Barcelona Innovation Hub** e.g. combines research, education, and applied technology deployment, functioning as a hybrid university–corporate node within the broader ecosystem.

Collectively, these platforms form a globally distributed yet increasingly coordinated infrastructure that enables elite

sport organizations to test, validate, and deploy emerging technologies at speed. In ecosystem terms, they suggest a shift from fragmented experimentation toward more **vertically integrated innovation architectures**, with corporate and governing stakeholders assuming greater orchestration roles.

Technology Development Focus Areas

The primary focus areas of innovation within the elite sport ecosystem include **athlete monitoring systems** capable of delivering high-resolution, real-time data; **biomechanical analysis tools** designed to optimize movement efficiency and skill acquisition as well as fatigue estimations with the intention of reducing injury risk; **recovery and rehabilitation technologies** that expedite return-to-play timelines; and **personalized digital twin models** that may predict adaptation based on individual physiological profiles. Increasingly, innovations in **anti-doping technologies and competitive integrity monitoring systems** are also gaining traction, particularly within Olympic and professional sporting domains. A notable example is the development of **Athlete Biological Passport**, which allows the longitudinal monitoring of multidimensional markers, and the contribution of artificial intelligence tools in enhancing test accuracy and support the detection of atypical performance and biological patterns (Olfa, 2024).

Success Metrics and Validation

Unlike commercial sport and fitness markets, where innovation success is typically measured in terms of user adoption or revenue, **elite sports technologies are validated through their direct impact on performance outcomes**. Validation demands rigorous testing analysis often in conjunction with academic institutions. Innovations that pass elite-level scrutiny often migrate into broader commercial markets or public sector applications, but their inception remains tightly tied to elite performance contexts.

Innovation takes shape in many forms across the sport-business industry. While this paper focuses primarily on technology and innovation that supports player performance, the **SportsTechX framework** (2017) highlights exponential growth in innovation for **fan engagement, management and media**. Fan engagement uses artificial intelligence, augmented reality, apps, and data analytics to create omnichannel interactive experiences to foster deeper emotional connections, drive loyalty, and develop new revenue streams for organizations. Clubs, leagues, and platforms now use fan data systems, integrated mobile and content platforms, fantasy sports and betting tools, and real-time analytics to personalize content and keep fans engaged before, during, and after competition. Executive-side sport tech innovation is increasingly concentrated in media and content infrastructure, sponsorship analytics, venue and event operations, and governance systems, with technologies focused on direct-to-consumer distribution, automated content, sponsorship valuation,

and smart venue infrastructure — domains where value is defined by scalability, revenue, and operational efficiency rather than on-field performance. Our perspective presented in this paper however primarily discusses the infrastructure needed to support performance, recovery, and injury mitigation innovation with athletes/exercisers and practictioners as end-users.

Commercial Sport Innovation Ecosystem

The commercial sport innovation ecosystem encompasses the full spectrum of market-driven entities pursuing revenue opportunities in sports technology, from bootstrapped startups to multinational technology giants. This diverse ecosystem operates based on market demand signals, scalability requirements, and the development of sustainable business models.

Venture-Backed Startup Segment

Venture-backed startups represent the **high-growth segment** of commercial sport innovation, typically securing **external funding** to accelerate product development and market penetration. These companies benefit from investor expertise, expanded development resources, and strategic guidance while facing **pressure to achieve rapid scale and market dominance**. They often target large addressable markets with potentially disruptive technologies, leveraging significant capital to outpace competitors and establish market leadership positions before competitors can respond.

Bootstrap and Self-Funded Companies

Bootstrap companies achieve growth through **organic expansion and founder investment**, maintaining complete operational control while building sustainable revenue streams from the outset. These ventures typically start lean, emphasize the early integration of direct customer feedback, and iterate rapidly based on market validation signals. They often identify and serve **niche markets or underserved segments that larger players overlook** due to scale requirements, creating opportunities for specialized solutions and direct customer relationships.

R&D Labs in Corporate and Technology Giants

Beyond ecosystem-facing innovation platforms, a significant share of sports technology development occurs within the **internal R&D infrastructures of large corporations and technology companies**. Established sport brands such as **Nike**, **Adidas**, **Decathlon**, and **Under Armour** maintain dedicated research laboratories, materials science divisions, biomechanics testing centers, and digital product teams that drive proprietary product innovation. These organizations operate **closed innovation pipelines** in which design, prototyping, athlete testing, manufacturing, and commercialization occur within tightly controlled corporate structures. Rather than serving primarily as integrators of external startups, they often use acquisition, strate-

gic partnership, or licensing as **extensions of internal R&D strategy**.

In parallel, large technology firms have entered sport and performance markets by **extending core platform capabilities** into health, fitness, and human performance domains. Companies such as **Apple**, **Google**, and **Samsung** embed sport-related functionality within broader hardware–software ecosystems, combining wearable sensors, operating systems, cloud infrastructure, and AI-driven analytics. Unlike traditional sport manufacturers, these firms do not merely launch products; they construct **interoperable device environments and data platforms** that define the terms of participation for downstream developers, partners, and consumers.

This **vertically integrated R&D model** differs structurally from federation- or league-embedded innovation hubs. Corporate and technology giants often possess the capital resources, manufacturing depth, and global distribution reach to internalize experimentation and rapidly move validated innovations from development to scale. At the same time, platform control over data standards and operating systems positions these firms to influence which technologies achieve interoperability, visibility, and broader market legitimacy.

As a result, **internal corporate R&D labs and technology platforms** function as both innovation engines and gatekeepers within the sports technology ecosystem. Their investment decisions and integration strategies can **influence how performance analytics, wearable technologies, and digital health markets evolve**, often establishing technical standards and competitive conditions that emerging ventures must navigate rather than define. Through tightly integrated hardware, software, and data infrastructures, these firms can also shape or create entirely new market categories in ways that smaller competitors struggle to replicate.

Success Factors and Market Dynamics

Success across commercial segments depends on **precise market timing, efficient customer acquisition costs, sustainable competitive differentiation, and operational scalability, while maintaining product-market fit**. The ecosystem rewards entities that can effectively balance innovation velocity with market validation, resource optimization with growth investment, and technological sophistication with user accessibility across diverse commercial market segments.

III. The MIT Theory and Framework

MIT's research on innovation ecosystems, developed by Budden and Murray (2019), identifies **five essential stakeholders** that must collaborate to create environments where innovation-driven enterprises can emerge and scale: **entrepreneurs, risk capital providers, universities, large corporations, and government**. This framework moves beyond the traditional "triple helix" of industry-government-university relationships to reflect 21st-century realities where dense networks of interconnected actors drive innovation through formal and informal resource exchange.

Additionally, the MIT framework (Budden & Murray, 2018) identifies that **effective innovation ecosystems require two distinct but interconnected capacities**: i) **innovation capacity** for developing new-to-the-world ideas from inception to impact, and ii) **entrepreneurship capacity** for forming and scaling innovation-driven enterprises. These capacities are built through **five critical drivers: human capital, funding, infrastructure, demand, and culture/incentives**. Formal ecosystem models in sport management describe activation phases, infrastructure alignment, cooperative strategies, and iterative evaluation cycles (Canini et al., 2026). These structural elements underscore the importance of **coordination**; however, sustainable sport technology innovation also requires alignment across innovation capacity, entrepreneurial capacity, and translational infrastructure. Without such alignment, ecosystem activity may increase without producing durable impact.

Success depends on understanding innovation as a complex systems phenomenon where stakeholder groups must collaborate across different governance levels to strengthen the linkages between innovation and entrepreneurship capacities. By taking a complex-systems perspective, we recognize the dense network of interconnections, dynamic information flows, and mutually shaping activities that bring multiple actors together and co-implicate them in the emergence of innovation (Katz, 2016; McLean et al., 2024).

When applied to sport innovation ecosystems, the MIT framework adopts unique characteristics that leverage sports' natural advantages as innovation hubs. **Sport entrepreneurs** bring deep understanding of athlete, fan, coach, and industry pain points; **risk capital providers** must navigate sports' unique market dynamics and seasonality; **universities** contribute sports science research and testing environments; **large sport corporations** (teams, federations, brands) offer real-world validation and distribution channels; and **governments** recognize sports as sources of civic pride and economic development.

The interconnected nature of these stakeholders emphasizes that successful ecosystems require collective action among all five groups. In sport innovation contexts, this translates to ensuring **athlete-centered design and long-term feasibility and sustainability of innovation**. Fresh EU guidance from the SHARE 2.0 Community of Practice crystallizes this point: to scale sport-sector innovation, the Commission urges simplified cross-border rules, targeted finance for start- and scale-ups, and coordinated procurement, positioning sport as a test-bed for broader EU competitiveness goals (European Commission, 2025). This logic aligns with MIT's ecosystem framing that couples innovation capacity with entrepreneurship capacity to sustain impact across stakeholders.

IV. Stakeholders

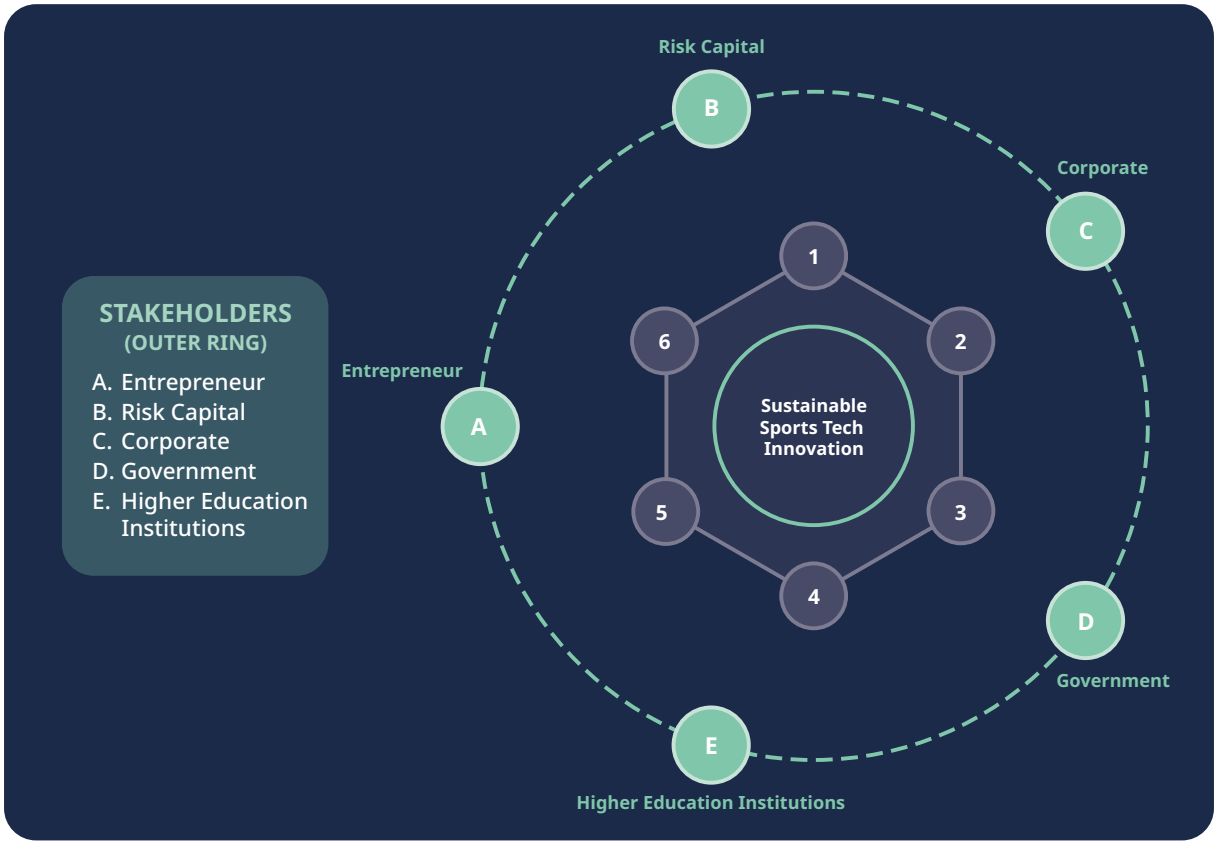


Figure 1: Stakeholders for Sustainable Sports Tech Innovation
This figure identifies the five key actor categories whose collaboration is essential for sustainable sports tech innovation. Entrepreneurs (A) drive ideation and commercialization; Risk Capital (B) provides financial foundation and market validation; Corporations (C) offer distribution, testbeds, and scaling capacity; Government (D) shapes regulatory frameworks, funding mechanisms, and infrastructure; Higher Education Institutions (E) contribute research expertise, talent pipelines, and legitimacy. The circular arrangement emphasizes that sustainable innovation requires dynamic, non-hierarchical collaboration among all five groups.

A. Entrepreneur

In the context of the Industry 5.0 era — shaped by edge computing, IoT, robotics, and balanced by human creativity and critical thinking — the definition of entrepreneurial activity, and of the entrepreneur in particular, takes on renewed significance. Industry 5.0 extends beyond the automation and digitization of Industry 4.0 by emphasizing a symbiotic relationship between humans and machines (Bazel et al., 2024). For sport entrepreneurship, this presents both opportunities and challenges, as new innovations must combine technological sophistication with athlete-centered design and human adaptability.

A **contemporary understanding of entrepreneurship goes beyond individual enterprising activity**. It includes the proactive identification of opportunities and the creation of innovative solutions capable of adding value (be that economic, cultural or social) within a given context (Deakins & Scott, 2021). By adopting this perspec-

tive, **individuals across sectors** — whether self-employed professionals, founders, researchers, coaches, analysts, or investors — **can actively contribute to an organization's innovation processes**. This global perspective on entrepreneurial activity is supported by leading international bodies such as the OECD (Ahmad & Seymour, 2008), which highlights that entrepreneurial activity often emerges organically rather than through formal planning, and that no specific organizational "vehicle" is required. Independent entrepreneurs, even without employees, can foster innovation by designing new products, services, and processes.

Within the sports tech ecosystem, the roles and profiles of entrepreneurs are diverse. In Academia, **universities pursue dual missions**: **disseminating established knowledge** through teaching and outreach, and **creating new knowledge** through research (Engwall, 2020). Yet academic environments are often characterized by **hierarchical structures, where teaching, research, and knowledge transfer operate in silos**. These silos limit risk-taking and constrain scalability, while knowledge transfer activities frequently lack meaningful connections to commercial outcomes (Hamilton & Philbin, 2020). By contrast, the **sports tech sector demands rapid prototyping, cross-disciplinary collaboration, and high adaptability** — highlighting the need for academic institutions to adopt an **entrepreneurial mindset** and become more actively involved in solving real-world problems.

Entrepreneurship also emerges within **national governing bodies, sport clubs, and federations**, where directors, coordinators, coaches, and practitioners are increasingly expected to drive innovation by translating lived performance challenges into applied solutions. In these settings, entrepreneurial activity is typically motivated by the **need to solve immediate, high-stakes problems and with a perceived or real pressure of avoiding competitive disadvantage**. The adoption and sustainability of technology within a sport setting rely on a variety of factors including technology proficiency, athlete impact, time, self-efficacy of practitioners, organizational trust and social influence (Jaswal et al, 2022). Overcoming these limitations requires **fostering closer interaction** between practitioners, communities, and other stakeholders to encourage innovation at the organizational level.

In addition, the longevity and success of startups and spin-offs in sports tech depend heavily on the **commitment and vision of their founders** — whether researchers, engineers, or managers. These entrepreneurial actors often focus on developing products or services that address pressing market needs, from athletic performance enhancement to fan engagement and public health promotion. Yet **many lack critical resources** for problem validation, product testing, prototyping, and successful market launch, exposing vulnerabilities in the ecosystem.

Given the dynamic nature of innovation within the sports tech landscape, the **characterization of a typical entrepreneurial profile** is highly relevant. Internal drivers such as achievement and autonomy, alongside external incentives like income and prestige, strongly influence entrepreneurial behavior (Carsrud & Brännback, 2009). **In sports tech, passion is particularly prominent**. Winand et al. (2022) identified three forms of passion that fuel sport entrepreneurs: **passion for sport, passion for inventing, and passion for work**. This motivational triad fosters resilience, long working hours, and a commitment to creating meaningful impact on society through new products and services. Passionate entrepreneurs often channel their energy into driving creativity, innovation, and broader adoption of sports technologies.

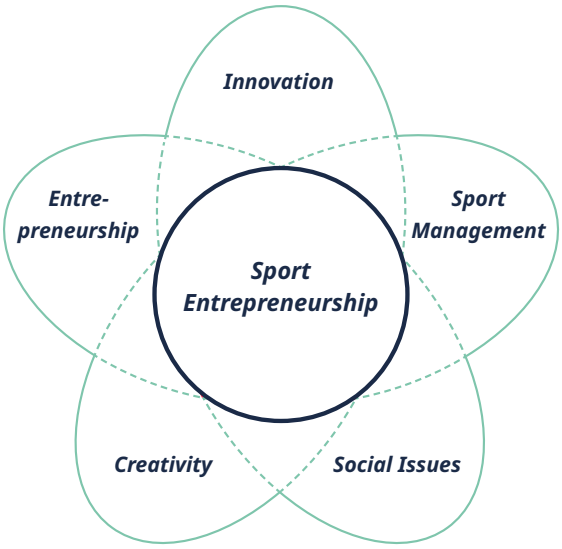


Figure 2: Adapted from Hammerschmidt et al. (2023).

In addition, sport entrepreneurship should be viewed from multiple, interconnected angles, as emphasized in the integrated model by Hammerschmidt et al. (2023). Existing research shows that the field has long been fragmented, with studies focusing separately on entrepreneurship, innovation, creativity, or social value creation, rather than examining their combined dynamics within sport management. Scholars have noted that sport entrepreneurship overlaps with innovation processes and depends on individual creativity, organizational conditions, and broader social and technological forces, making a holistic perspective essential for conceptual clarity and theoretical coherence. The **integrated model** brings these strands together by illustrating how **entrepreneurial behaviour in sport** emerges from the **interaction of economic, social, creative, and technological dimensions**, thereby offering a more complete understanding of how value is created through sport. At the same time, the model highlights **gaps in the literature** — particularly the limited research on creativity, sustainability, and the individual sport entrepreneur — which future studies should address to strengthen and refine this multidimensional framework.

Finally, it is essential to recognize **ecosystem facilitators** — individuals whose diverse contributions inspire new directions in sports tech innovation. For example, certain **researcher-entrepreneurs** have helped democratize access to advanced performance testing by developing scientifically validated mobile and web-based applications that rely on smartphone cameras (Buchheit, 2008; Balsalobre-Fernández et al., 2024). Similarly, **practitioner-scholars** have shaped both practice and research by widely disseminating evidence-based knowledge, development of academic-industry partnerships, mentorship and consultancy. While not intended as prescriptive models, these cases illustrate how entrepreneurial impact can emerge across multiple roles and platforms, highlighting the diverse ways actors shape the future of sports tech.

B. Risk Capital

As a defining stakeholder in the sports technology ecosystem, risk capital provides the **financial foundation for early-stage innovation**, underwriting uncertainty when revenues are unproven and outcomes are unpredictable. In practice, risk capital enters the ecosystem through **four principal channels: venture capital, angel investors and syndicates, corporate or strategic investment, and public grants or seed instruments**. While these mechanisms mirror broader innovation economies, their influence in sports tech extends beyond funding. They determine which ideas are validated, which business models are pursued, and which technologies achieve market readiness. In this sense, risk capital serves as both an enabler and a gatekeeper of innovation.

In mature ecosystems, **venture capital dominates**. Investment typically targets scalable, IP-intensive solutions with potential crossover into adjacent sectors. This reflects a broader global pattern in which capital increasingly gravitates toward **data-rich, software-driven technologies**. In 2024, AI-related ventures captured over half of global venture capital inflows, while funding for non-AI sectors declined (FDI Intelligence, 2025). For sports tech entrepreneurs, this creates both opportunity and pressure: aligning with these broader technological narratives can attract institutional capital but may also push products to be framed beyond the athletic domain. **Angel investors and syndicates**, by contrast, play a more pronounced role in **less mature ecosystems**. Their investments are often motivated by personal ties to sport or local development goals, and their involvement extends beyond financing to include mentorship, expertise, and access to early customers. Empirical evidence demonstrates that angel participation in early rounds correlates with **higher firm survival and innovation performance** (Karlsen, Fossen, & Sørensen, 2024).

Corporate and strategic investors — such as leagues, federations, and technology firms — add another layer of complexity. Their innovation funds, pilot programs, and joint ventures can provide valuable access to data, facilities, and athlete cohorts. However, these investments are frequently structured for **strategic alignment rather than scalable growth**. As a result, ventures supported through such partnerships may achieve proof-of-concept success but face **challenges in attracting follow-on commercial funding**, particularly when intellectual property or revenue-sharing arrangements restrict flexibility.

Public funding mechanisms play a complementary and catalytic role in this landscape. Programs modeled on the U.S. Small Business Innovation Research (SBIR) initiative have been shown to significantly increase innovation outputs and double the probability of subsequent venture funding (Howell, 2017). Similarly, European frameworks such as Horizon Europe and Smart Specialization initiatives support early-stage prototyping and data infrastructure devel-

opment, although their impact depends heavily on the availability of commercialization support and private follow-on investment (Santoleri et al., 2022).

The **structure of risk capital also varies markedly across ecosystems and geographies**, standing as a significant barrier to providing equitable opportunities for early-stage financing and the full support required to move innovations from ideation to market launch and scaling. **Mature hubs** with established investor networks and research capacity attract institutional capital that favors scalable, data-intensive ventures with health or AI crossover potential. **Emerging ecosystems** rely more on angels and public grants, with smaller deal sizes and lower risk tolerance, often prioritizing locally relevant innovations focused on participation, injury prevention, or community impact. **Federation-linked environments** frequently allocate capital through innovation funds or in-kind contributions such as access to athletes, data, and facilities. These mechanisms foster technology validation but often lack the financial pathways necessary for commercial scaling.

Across all ecosystems, a critical question emerges within the context of risk capital: **to what extent does quality truly matter?** In academic spinoff and elite sport environments, entrepreneurs and end users typically prioritize reliability, validity, and rigorous testing within clearly defined populations, as scientific credibility is central to trust and adoption. In contrast, **commercial sport tech ecosystems often operate under a different logic**. From a funding and scaling perspective, product quality, as defined by scientific rigor, is not always a prerequisite for widespread market adoption. When end users perceive a technology as desirable or necessary, purchasing and adoption may occur in the absence of robust evidence of efficacy.

This dynamic elevates the **role of marketing and sales as critical intermediaries between innovation and investment**. The ability to articulate a compelling product narrative — one that resonates with individual needs, aspirations, or identities — can outweigh empirical validation in determining market traction. Consequently, capital frequently flows toward solutions that demonstrate clear pathways to scalability and user acquisition, rather than those with the strongest scientific foundations. In this context, **storytelling becomes a mechanism for reducing perceived market risk**: ventures that effectively identify their audience and communicate value through relatable, influential channels are often viewed as more investable, even when scientific evidence lags behind adoption.

Ultimately, risk capital defines both the velocity and the direction of sports tech innovation. **By determining what types of projects appear "investable," it shapes the balance between commercial scalability and athlete-centered value**. The growing global bias toward AI and data-driven solutions signals an urgent need for ecosystem alignment: sustainable sports tech innovation will depend on blended financing models that pair public de-risk-

ing with private growth capital. When effectively structured, such models can ensure that technological progress remains consistent with the human-centered values that define the Industry 5.0 era.

C. Corporate

Corporate actors are integral stakeholders in technology innovation, functioning as ecosystem anchors or global participants — entities capable of influencing innovation not only through investment but also via convening power, testbeds, and infrastructure. In the sports tech domain, large corporations primarily engage through **three channels: mergers and acquisitions (M&A), corporate venture capital and accelerators, and licensing or co-development partnerships**.

In mature ecosystems, corporations often act as scaling engines rather than purely local anchors. For example, consumer-electronics or sports-apparel corporations leverage existing global distribution networks, robust supply chains, and brand equity to commercialize sport-tech innovations at scale. Large firms strategically deploy corporate venture capital (CVC) to strengthen their core businesses, tap emerging technologies, and leverage innovation ecosystems (Pinkow & Iversen, 2020). The marketplace supports this: in the first half of 2025, the global sports-tech industry recorded $51.9 billion across 503 deals, including 233 M&A transactions (Schaefer, 2025), therefore underlining how **corporates, through acquisitions and investment arms, are actively shaping the sector**. An example of such is Hudl, one of the leading cloud-based video and data tools providers for sports organizations, that has been consistently acquiring new companies over time to expand their portfolio, including five just in 2025. The fragmentation of sports tech ecosystem is progressing into a potential monopoly that may positively contribute to a consolidation of data and interoperability between platforms but, at the same time, may raise concerns on data privacy and innovation potential.

Corporations also engage through **innovation arms and accelerators**. Studies show that start-ups participating in corporate-backed accelerator programs display improved survival and innovation outcomes when mentors, domain access, and commercialization support are present (Assenova & Amit, 2024). Within sports tech, these programs allow corporates to source entrepreneurial talent, experiment with new business models, and validate technologies, contributing to overall ecosystem infrastructure (labs, testbed access, talent pipelines).

In co-development and licensing models, sports tech firms partner with large organizations (technology firms, leagues, federations) to deliver new solutions in performance, fan engagement, or wellness. Empirical work in the sports-equipment manufacturing sector demonstrates how partnerships and information sharing enhance corporate sustainable performance, particularly under supportive governance and ecosystem conditions (Yue, Ye & Chen, 2022). These findings parallel the larger innovation ecosystem where corporations can provide space, facilities, and convening power for ecosystem development — but only when strategic alignment and resource contributions are substantive.

Not all ecosystems, however, benefit equally from corporate involvement. In league- or federation-centric ecosystems, corporations tend to act as partners rather

than acquirers, providing testbed access but often lacking commercial-scale mandates. In emerging regions, the absence of deeply embedded anchor corporations means fewer scaling platforms, less infrastructure for commercialization, and more reliance on universities and public funding. Without "anchor" corporations aligned with regional comparative advantage (e.g. manufacturing, data science, or sport performance hubs), ecosystem maturity is constrained. In sports tech terms, this inequality means that innovation may stagnate during the pilot phase despite its technical promise.

The most effective corporate players in sports tech operate as platforms for innovation rather than as transactional bottlenecks. They deploy CVC and accelerators, provide testbeds and distribution, and participate in ecosystem governance — thereby accelerating diffusion and enabling scalable impact. When large firms align strategic objectives with athlete- or human-centered design frameworks, they help to build symbiotic human-machine systems. Conversely, if corporations engage in a siloed manner, they risk fragmenting the ecosystem and limiting inclusive innovation.

D. Government

Government entities shape the rules, incentives, and infrastructures that determine whether those ideas scale within innovation ecosystems. In the MIT Innovation Ecosystem Framework, government stakeholders function as engaged ecosystem builders, not necessarily leaders or idea generators, but critical conveners and rule-setters whose participation is essential to sustained innovation. In sports technology, **government decisions directly affect how quickly performance tools move from lab to field**. Through funding mechanisms, tax credits, regulation, procurement structures, and facility access, governments can either **accelerate** or **constrain** innovation (Conti, 2025).

Governments enable innovation by reducing risk and extending capacity through public investment and incentives. The UK Government funds the UK Sports Institute's performance innovation program, integrating sensor and analytics technologies into elite training. Australia's $250 million upgrade to the Australian Institute of Sport modernizes performance infrastructure ahead of the 2032 Olympics, fusing national prestige with technological progress. Taiwan's "Sports × Technology" strategy aligns industrial policy with athlete development, turning elite training into a domestic innovation platform. Supranationally, the European Union's Horizon Europe and European Innovation Council embed entrepreneurship support within cross-border R&D networks, while U.S. federal initiatives such as the SBIR/STTR grants and Regional Tech Hubs channel early-stage capital and infrastructure toward small technology firms. Together these initiatives exemplify how governments cultivate both innovation and entrepreneurship capacity by **linking R&D funding, infrastructure, and commercialization pathways** (Chen, 2025).

Regulation defines the limits of innovation and ensures user safety, data integrity, and product reliability and validity. **The United States** applies a flexible model in which the FDA exercises enforcement discretion for low-risk wellness devices, accelerating market entry for performance wearables while enforcing stricter standards for diagnostic claims when crossing into medical use. **The European Union** pursues the opposite philosophy, with the Medical Device Regulation, AI Act, and GDPR together imposing stringent documentation, transparency, and privacy requirements. **Asia-Pacific systems** experiment with adaptive oversight — Singapore's regulatory sandboxes and Taiwan's forthcoming Ministry of Sports reflect attempts to institutionalize agility. In this overall context, Guppy (2023) notes that elite-sports technologies often outpace their ethical and regulatory frameworks, emphasizing that adaptive guardrails are as essential to athlete welfare as to innovation itself.

Beyond funding and regulation, governments act as **gatekeepers** by determining which technologies gain **access to public facilities, procurement pipelines, and data systems**. At institutions like the UK Sports Institute, Canadian Sport Institute, and the Australian Institute of Sport, government control of athlete access and facility use creates structured, ethical environments where startups can validate products in collaboration with researchers and national teams. In the U.S. and EU, procurement-driven innovation models show how public contracts can stimulate market demand for new technologies, effectively transforming government from a passive buyer into an active co-developer. This gatekeeping function, when transparent and evidence-based, ensures that innovation benefits the performance ecosystem rather than only private interests.

Government engagement unfolds across multiple levels — national, regional, and local — and across diverse agencies, from sport ministries to departments of trade, education, and health. Effective innovation systems depend on coordination among these levels rather than on any single policy instrument. Chen (2025) demonstrated that **government "attention"**, or the explicit prioritization of innovation in policy agendas, translates into **greater regional corporate innovation** when coupled with coherent fiscal tools and institutional alignment. Further, innovation-driven policies, such as subsidies and R&D expense deductions, play a crucial role in encouraging sports firms to engage in innovation and allocate more resources to R&D, ultimately enhancing their market value and long-term growth potential (Ding & Chen, 2022). Fragmented governance, by contrast, leads to duplication and diminished impact.

E. Higher Education Institutions

Higher Education Institutions (HEIs) are often viewed primarily as sources of research and talent, but their role within sports tech innovation extends much further, as already outlined earlier in this document.

Increasingly, they serve as **ecosystem orchestrators, infrastructure providers, and legitimacy anchors**. Their long-term presence, multidisciplinary expertise, and credibility position them uniquely to shape the evolution of sports tech ecosystems.

At present, the industry remains fragmented, with inconsistencies in product quality, a lack of interoperability frameworks, and limited cooperation across stakeholders. Universities can help address these gaps by **fostering neutral platforms for dialogue, data sharing, and cross-sector experimentation, thereby stabilizing the broader ecosystem**. As Ratten and Jones (2020) note, sport entrepreneurship is often constrained by inconsistent funding, weak policy backing, and short innovation cycles. HEIs can counteract these challenges by leveraging their convening power and strategic foresight to align diverse stakeholders across sport, health, and technology domains.

HEIs also hold potential as **policy intermediaries**. Sports tech innovation often falls between policy silos, as health ministries, sports authorities, and economic agencies frequently operate independently, resulting in inefficiencies. Universities can bridge these divides by aligning their agendas and unlocking multi-source funding opportunities, such as **regional innovation frameworks** (e.g., INTERREG, Smart Specialization in Europe). At the same time, HEIs are well-positioned to internationalize regional ecosystems, forming **global research consortia, joint ventures, and collaborative funding mechanisms** that extend the reach and impact of local innovation. Initiatives such as COST Actions demonstrate how academic institutions can structure stakeholder mapping, taxonomy creation, and needs assessment across borders. At the minimum, HEIs serve as an intellectual neutral spaces where like-minded entrepreneurs, makers, funders, and sporting organizations can meet to exchange and move ideas into reality.

Despite this potential, **cultural challenges** persist, particularly in preventive health and sport research, where commercialization is sometimes viewed with skepticism. As Clarysse and others argue, **entrepreneurship and societal impact are not mutually exclusive**; rather, commercialization can serve as a mechanism for delivering public value when public institutions lack the agility to innovate alone (Clarysse et al., 2023, Greven et al., 2025). Training programs that demystify commercialization, share real-world success stories, and frame entrepreneurship as a vehicle for societal benefit can help shift internal cultures. External partnerships at the regional, national, and international levels can further embed this entrepreneurial perspective into institutional practice.

Despite strong research capabilities, **universities often face a steep gap when trying to commercialize sport-tech innovations** — a phenomenon the University Industry Innovation Network (UIIN) calls out in its deep-tech analysis. The report highlights systemic barriers such as long development cycles, capital-intensive R&D, and investor hesitation, because many VCs favour fast returns over patient, high-risk projects. Spin-out practices aggravate the problem: rigid equity demands and inflexible licensing terms from universities discourage external investors (UUIN, 2025). Meanwhile, **many Technology Transfer Offices remain bureaucratic gatekeepers instead of acting as ecosystem connectors, slowing commercial progress**. UIIN argues that closing this commercialization

gap requires universities to rethink their models — by revising licensing and equity approaches, opening infrastructure, building entrepreneurial capacity, and leveraging their convening power to unite investors, policymakers, and industry. Without such changes, many promising sport-tech discoveries risk languishing in the lab instead of reaching the market.

Ultimately, HEIs must adopt a **dual strategy** urgently: strengthen their internal entrepreneurial mechanisms while positioning themselves externally as indispensable hubs within sports tech ecosystems. This requires institutional agility, proactive leadership, and sustained investment in infrastructure to support innovation and commercialization. Without such evolution, universities risk marginalization in one of the most dynamic and impactful industries of the 21st century, as private actors and technology giants increasingly dominate the sports innovation space. By contrast, universities that embrace their dual role as both **knowledge creators** and **ecosystem coordinators** will be central to ensuring sports tech innovation remains sustainable, inclusive, and impactful.

The collective action of these five stakeholders — Entrepreneurs, Risk Capital, Corporates, Government, and HEIs — forms the foundation of the innovation ecosystem (the 'Who'). However, their presence alone is insufficient to guarantee success. The ecosystem's maturity depends on these actors actively cultivating the capacities (the 'How') that fuel innovation and entrepreneurship. We now examine these critical drivers as they apply to the unique context of sports technology.

V. Drivers of Innovation in Sports Tech Across Ecosystems

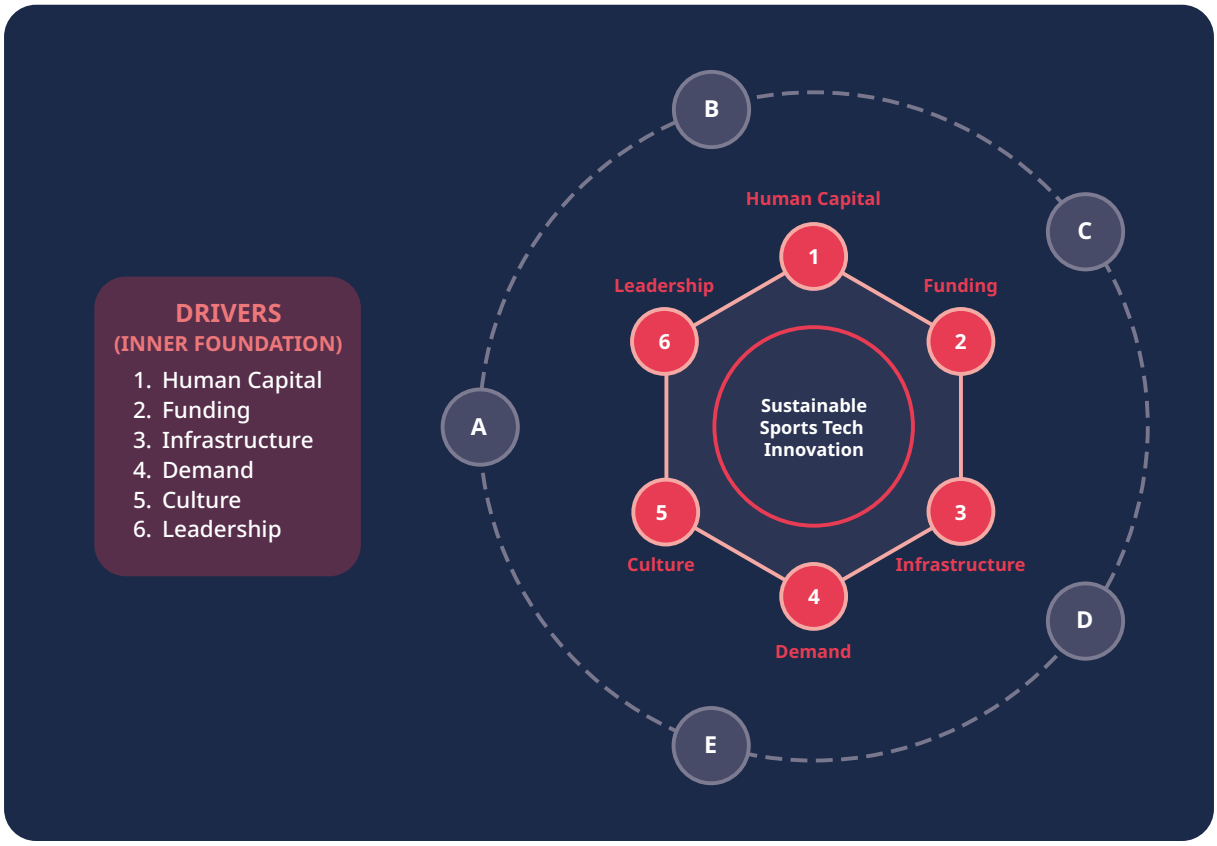


Figure 3: Drivers for Sustainable Sports Tech Innovation
This figure illustrates the six foundational conditions that enable sports tech ecosystems to flourish. Based on the MIT Innovation Ecosystem Framework (Budden & Murray, 2019), these drivers function as structural enablers: Human Capital provides interdisciplinary expertise bridging technical and domain knowledge; Funding/Risk Capital addresses the "valley of death" between prototype and scale; Infrastructure encompasses data platforms, regulatory frameworks, and testing environments; Demand from athletes, coaches, and consumers shapes product development; Culture & Incentives promote risk-taking and cross-sector collaboration; Leadership & Vision unites stakeholders under shared missions. Weakness in any driver constrains the entire ecosystem.

Innovation ecosystems, as described in the MIT Framework (Budden & Murray, 2019), are fueled by five key drivers: **human capital, funding, infrastructure, demand, and culture & incentives**. These components work in concert to transform ideas into scalable impact by creating environments that enable entrepreneurs and innovators to thrive. In conventional sectors, this framework has guided regional innovation strategies around industries such as biotechnology, energy, and manufacturing. However, the unique characteristics of sports technology necessitate reconceptualizing these drivers to address the interdisciplinary nature of athletic performance enhancement, the complex regulatory environment of sports, and the diverse stakeholder ecosystem.

1. Human Capital

In sports technology innovation, it is not enough to have talent with a background in engineering or business; successful sports tech development requires individ-

uals who **combine technical expertise with domain-specific knowledge and lived experience**. In this case, human capital extends beyond traditional STEM roles, encompassing a diverse blend of engineers, scientists, data analysts, clinicians, and entrepreneurs. This interdisciplinary talent helps with the complex landscape of technical development and market application, enabling innovation that is both **technically sound and contextually relevant** to the needs of athletes, coaches, and consumers.

Developing this talent requires intentional strategies, including partnerships between academia and industry, mentorship programs, and continuous professional development opportunities. For instance, initiatives like the Sports Innovation Hub by Deloitte in Madrid aim to foster such collaborations, bringing together diverse stakeholders to drive innovation in sports. These efforts help cultivate a workforce capable of addressing the multifaceted challenges in sports technology.

2. Funding

Securing adequate funding is a pivotal aspect of advancing sports technology innovation. While early-stage investments are common, there is often a **significant gap in funding during the transition from prototype development to scalable implementation**. Addressing this "**valley of death**" requires a mix of public and private investment strategies that support ventures through various stages of growth (Gbadegeshin et al., 2022).

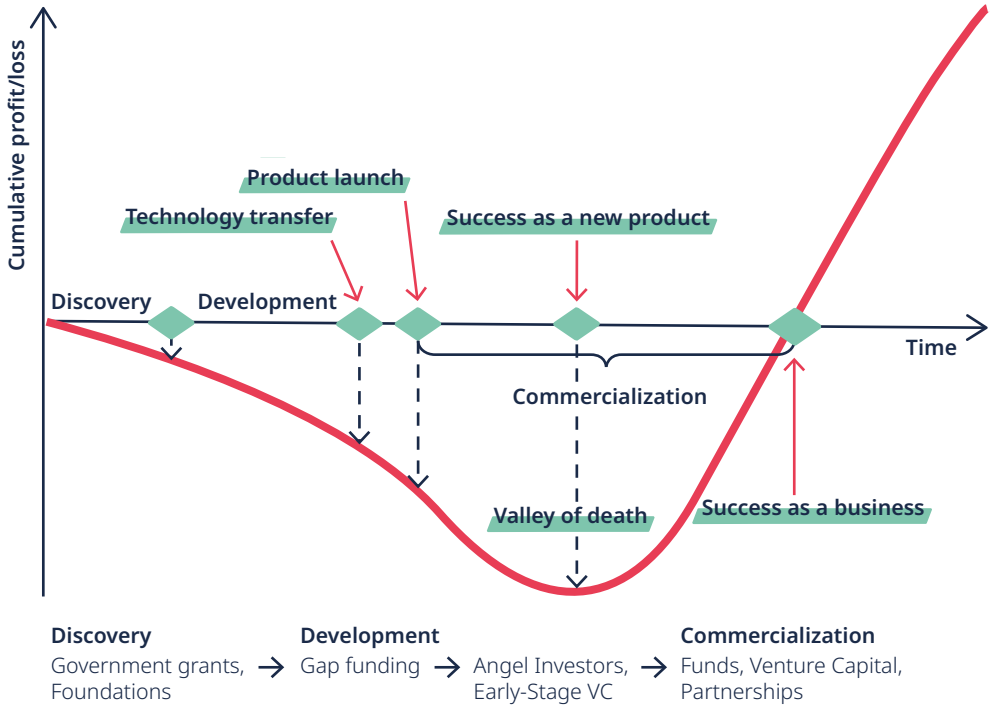


Figure 4: The "Valley of Death" in Sports Tech Commercialization

This figure maps the innovation lifecycle from Discovery through Commercialization, illustrating the critical funding gaps that threaten sports tech ventures. The "valley of death" represents the high-risk transition period between early development (supported by government grants, foundations, and angel investors) and commercial success (backed by venture capital, funds, and partnerships). Many promising technologies stagnate in this valley due to inadequate funding, validation challenges, or market-readiness gaps. Blended financing models combining public de-risking with private growth capital are essential for bridging this divide. This figure has been adapted from De Mey (2021).

Recent trends indicate a **growing interest from venture capitalists and private equity firms** in the sports sector. According to S&P Global Market Intelligence, private equity investment in sports service businesses peaked at $6.33 billion in 2025, keeping up with the growing trajectory observed over the previous six years. Within this context, Lalotte Ventures take the lead in North America, while Redbull Ventures holds a prominent position in Europe (SportsTechX, 2025). These investments not only provide the necessary capital but also bring **strategic guidance and industry connections** that are invaluable for scaling innovations.

Additionally, **public funding initiatives, such as government grants and innovation programs**, can play a crucial role in supporting research and development in sports technology. These programs can help **de-risk early-stage projects and encourage experimentation**, leading to breakthroughs that might not occur through private funding alone. A balanced funding ecosystem that includes both **public and private sources** is essential for sustaining innovation in the sports technology landscape.

3. Infrastructure

Infrastructure in sports tech goes **beyond traditional labs and office space**. It encompasses interoperable tech platforms for real-time data exchange, regulatory frameworks that ensure safety and credibility, collaborative R&D consortia, and formal education programs that foster innovation fluency. Moreover, innovation in sports tech is increasingly dependent on **soft infrastructure** — such as policies, partnerships, and financial models — that enable translation, testing, and scale.

Digital infrastructure, including data analytics platforms and interoperable systems, enables the collection and analysis of performance metrics, enhancing decision-making processes for athletes and coaches. Moreover, establishing clear regulatory standards ensures the data privacy, product safety, and efficacy of new technologies, fostering trust among users and stakeholders. Collaborative networks that bring together academia, industry, and government entities further strengthen the innovation ecosystem by promoting knowledge sharing and resource pooling.

Investing in **comprehensive infrastructure** that supports the entire innovation lifecycle — from ideation to commercialization — facilitates the development of cutting-edge solutions and ensures their successful integration into the sports industry.

4. Demand

In sports technology innovation, demand is a dynamic, multifaceted force that shapes not only what gets built but also how it is adopted and scaled. Unlike more homogenous sectors, sports tech must meet the needs of a wide range of users — elite athletes, coaches, practitioners, health systems, and everyday consumers — each with distinct workflows, priorities, and envi-

ronments. Mature ecosystems recognize that **demand is not just a downstream market condition; it is a strategic input that informs product development, validation, and deployment**.

To meet this complexity, sports tech must be built through the lens of **user-centered design**. Solutions must be intuitive, evidence-informed, and seamlessly embedded into real-world settings (Ranaweera et al., 2025). Whether supporting tactical decisions in elite sport or enabling behavior change in consumer wellness, products must align with the rhythms and constraints of daily use. This requires engaging users throughout the development process to ensure that technologies are not only functional but also relevant, usable, and capable of delivering sustained engagement and measurable outcomes.

Crucially, demand in sports tech is **interactive**, not passive. Users are co-creators whose feedback loops guide iterative improvement and shape the legitimacy of new technologies. Ecosystems must create structured pathways, such as pilot programs, collaborative testbeds, and performance-based procurement models, that enable demand-side actors to influence innovation early and meaningfully.

5. Culture & Incentives

Finally, culture & incentives in sports technology must support behaviors that promote **risk taking, translational work, and interdisciplinary collaboration**. Innovation thrives when there are clear incentives for crossing silos, institutional support for entrepreneurial experimentation, and leadership that values transparency and long-term vision.

Culture can also be understood as the **values and mission driving innovation**. In the realm of public health and prevention, there is still significant resistance to valorization. Many researchers view commercial activity as antithetical to public good, associating it with systemic problems like obesity and cardiovascular disease. Yet research by Clarysse et al. (2023) and others shows that **academic entrepreneurs are primarily motivated by societal impact, not commercial gain**. This misperception hinders the integration of entrepreneurial thinking into domains that could benefit most from scalable health innovations.

Studies have shown that engaging in valorization can actually **enhance the quality of academic research** (Fini et al., 2022), and that entrepreneurial academics often contribute to **higher levels of societal and scientific impact** (Miller et al., 2018). Structured training and exposure to real-world case studies can help shift this mindset, positioning entrepreneurship not as a compromise but as a complementary path to achieving public benefit.

A **new sixth pillar — Leader & Vision** — is particularly important in sports tech. Human-centered leaders who can unite stakeholders under a shared mission, navigate uncertainty, and foster talent develop-

ment are essential for ecosystem resilience and growth. **Experienced founders**, acting as both operators and mentors, help build momentum and legitimacy in the sector by modeling sustainable innovation practice.

These drivers do not emerge organically; they must be **cultivated intentionally across the Academic, Elite Sport, and Commercial ecosystems**. The interdependence of these elements highlights that a weakness in one area — such as a lack of supportive infrastructure or misaligned incentives — can undermine strengths in others. Ultimately, the presence of strong, human-centered Leadership and Vision is the catalyst that aligns these drivers toward a shared mission. However, innovation does not occur in a vacuum. **To achieve true sustainability and scale, the sports tech industry must look beyond its traditional boundaries**.

VI. Synergies & Overlap of Industries

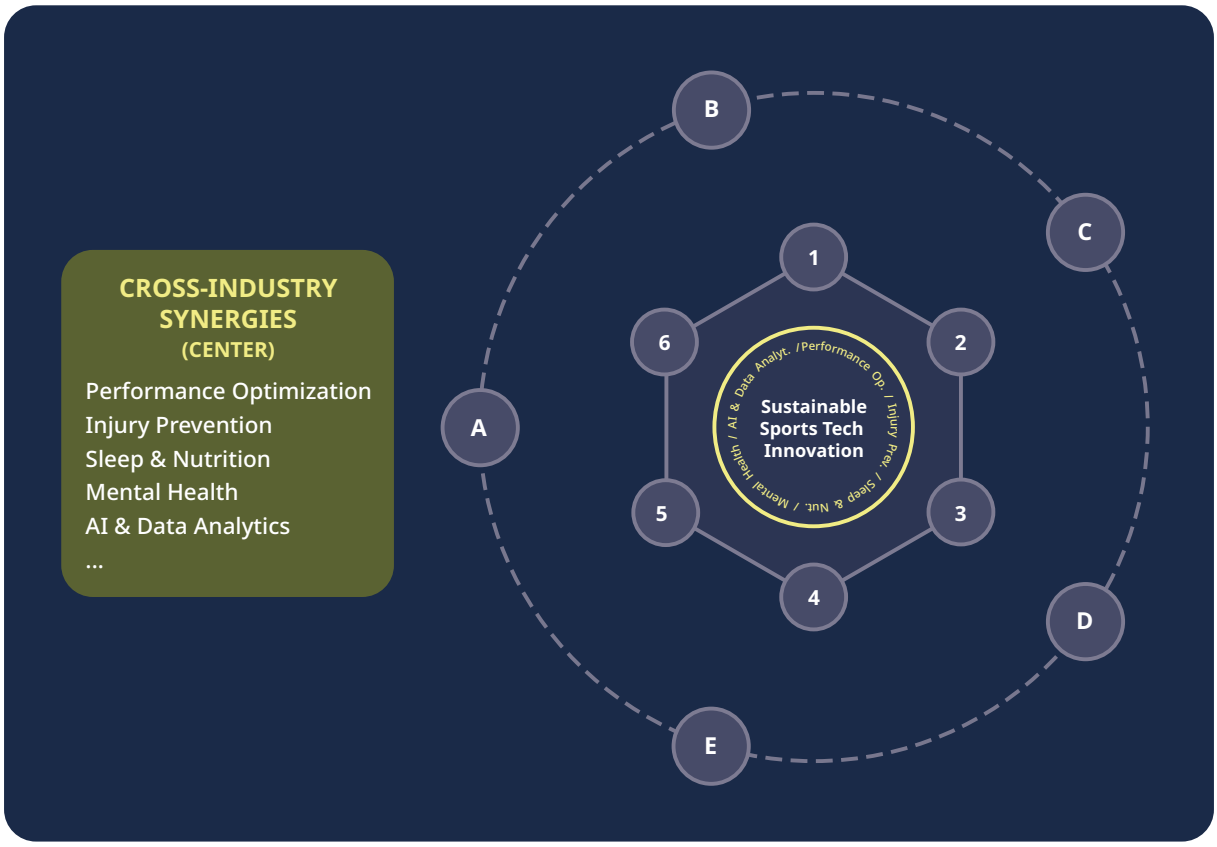


Figure 5: Cross-Industry Synergies and Overlap
This figure visualizes how sports tech innovation intersects with adjacent industries sharing common challenges and technologies. Healthcare (medical and clinical applications), Holistic Health (wellness and longevity), Tactical Domains (police, fire, military), and Occupational Health (worker safety) all address performance optimization, injury prevention, and recovery. The overlapping center highlights cross-industry innovation areas including AI and data analytics, sleep and nutrition optimization, and mental health interventions. These "dual-use" pathways offer sports tech ventures alternative funding sources, diverse validation routes, and powerful scaling mechanisms—reducing dependence on volatile elite sport markets alone.

A critical pathway toward a sustainable and resilient sports tech ecosystem lies in **strategic collaboration with adjacent industries**. Relying solely on the often volatile demands and niche markets of elite sport limits scalability and increases risk. However, shared challenges in human health and performance create natural synergies with sectors such as **holistic health** (including wellness and longevity), **healthcare** (medical and clinical), **tactical domains** (police, fire, and military), and **occupational health** (worker safety).

Across these fields, mutual needs exist in performance optimization, injury prevention and rehabilitation, mental health, data analytics and AI, and simulation-based training. These **"dual-use" pathways** provide **alternative funding sources, diverse validation routes, and powerful scaling mechanisms**. Furthermore, many of these industries are experiencing **substantial growth**, making them attractive partners for sports tech ventures. For example, the wellness sector alone is projected to reach remarkable scale: by 2030, brain health is estimated at $31B, sleep tech at $68B by 2032, and mental wellness at $262B by 2029 (Fitt Insider, 2025). These figures underscore the potential for cross-industry partnerships to drive revenue expansion, shared innovative processes, and translational mechanisms that strengthen the entire ecosystem.

Emerging Opportunities and Dual-Use Potential

Several technologies illustrate the dual-use potential of sports tech across industries demonstrating validity for cross-sector pathways. **Wearable biosensors**, initially designed for athletic monitoring, have been clinically validated for patient mobility tracking, reducing recovery times in rehabilitation (Latif et al., 2024). **Continuous glucose monitoring systems**, long used in diabetes management, are being adopted in elite sport for performance optimization (Helleputte, 2025).

Virtual-reality training platforms — first adopted in sports to train perceptual and decision-making skills — have been adapted for law-enforcement scenario training, where studies and police reports show improved decision-making and de-escalation performance in scenario-based drills (e.g., Kleygrewe et al. 2023; Muñoz et al. 2024). **Wearable sleep-tracking tools** — first popular in sports for recovery monitoring — have shown clinical efficacy beyond athletics. For instance, in aging populations, home-based sleep monitoring via wearables demonstrates feasibility and rich sleep-pattern data collection (Ghazi et al., 2025). And in workplace wellness programs, randomized trials using app-based sleep education plus personalized feedback (e.g., the dayzz programme) have improved sleep duration, reduced presenteeism, and lowered health-care utilization (Robbins et al., 2022).

Smart fabrics with embedded impact-sensing capabilities are showing promise not only for athlete safety — for

example, via textile-based sensors that detect high-force impacts in sports headgear (Saikia et al., 2024) — but also for ergonomic risk monitoring in industrial workwear (Vilarinho et al., 2025). Meanwhile, soft, military-inspired exosuits built from smart textiles are being adapted for rehabilitation: for example, a smart textile-driven spine exosuit reduced lumbar muscle activation during lifting tasks in experimental users (Zhu et al., 2023).

Biofeedback devices for stress regulation — particularly heart rate variability (HRV) biofeedback — are being piloted in both sports teams and tactical units. For instance, sports-shooting athletes show reduced autonomic arousal after HRV-biofeedback training (Donghai et al., 2024). At the same time, HRV-biofeedback is being trialed with law-enforcement officers (e.g., the iPREP protocol), showing increased autonomic resilience, though fully standardized protocols remain in development (Andersen et al., 2024).

These examples highlight a consistent pattern: **technologies validated in one context often migrate into others**. However, this process remains fragmented and reactive, with tools adapted ad hoc rather than being co-developed for multiple sectors from the outset. **Cross-sector innovation consortia** are emerging to address shared domains, including musculoskeletal health, human performance optimization, and virtual training; however, these efforts would benefit from more structured evaluation frameworks. Initiatives such as **STRN's Quality Framework for Sports Technologies** could provide standardized criteria for mutualized assessment across diverse use cases, enabling more efficient translation and adoption.

R&D Partners and Consultancy Firms

In the sports tech ecosystem, R&D partners act as **critical enablers of innovation** rather than direct owners of products or services. Their value lies in providing specialized expertise, infrastructure, and independent perspectives that accelerate development, reduce risk, and catalyze collaboration across stakeholders.

R&D partners — such as applied research institutes, translational labs, and cross-sector consortia — bridge foundational science with real-world application. As mapped in global sport-science networks, **universities and research centers play a central 'broker' role facilitating collaboration across sectors** (Erskine et al., 2024). SINTEF exemplifies this dual role: co-developing innovations with industry as a trusted partner, while also creating spin-off ventures from internally generated IP and research, funded with their own CVC.

Alongside these technical R&D players, **consultancy firms and high-performance training centers** bring complementary value. While they may not own products, consultancies and training centers translate emerging technologies into actionable strategies for teams, leagues, and investors. They provide market intelligence, regulatory insights, validation work, and commercialization roadmaps, and often act as intermediaries connecting startups with capital and buyers. Larger firms alongside boutique sport strategy groups are increasingly shaping the sports tech landscape by guiding adoption and scaling.

Together, R&D partners and consultancies provide the connective layer of the sports tech ecosystem — ensuring that promising

ideas are not only developed but also validated, trusted, and strategically deployed at scale.

Integration Challenges and Systemic Solutions

To ensure that sports tech innovation does not replicate the fragmented development patterns seen in adjacent sectors, **cross-industry collaboration must be embedded into strategic planning from the outset**. Recent analyses of digital-health and wearable-technology ecosystems underscore the importance of standardized validation frameworks, coordinated investment strategies, and industrial-policy approaches that encourage joint action across research institutions, industry partners, and government bodies (Rak & Quinn, 2024). Establishing shared testing environments, interoperable data architectures, and collaborative funding mechanisms can reduce duplication, accelerate translation, and raise trust in emerging technologies, echoing evidence from broader wearable-health research pointing to the crucial role of data governance and interoperability (Canali et al., 2022). By **institutionalizing** these collaborative structures early, the sports tech sector can develop as a cohesive, strategically aligned ecosystem that not only strengthens its own innovation pipeline but also contributes to advances in health, safety, and human performance across multiple domains — even in highly regulated contexts where harmonized pathways improve the likelihood of successful commercialization (Amaral et al., 2024).

VII. Conclusion: Pathways Towards Sustainable Ecosystems

The rapid evolution of the sports technology industry presents unprecedented opportunities for enhancing athletic performance, economic growth, and societal well-being. However, as this analysis has demonstrated, **the industry's potential is constrained by a significant lack of mature infrastructure, cohesive frameworks and synergistic partnerships**. The fragmentation across the Academic, Elite Sport, and Commercial innovation pathways, coupled with uneven development of key innovation drivers, has resulted in inefficiencies, volatility, and missed opportunities to sustain long-term innovation.

Drawing on the current state of the sports tech ecosystem — characterized by an asynchrony between the accelerated demand for product innovation and the ecosystem's capacity to respond — we identified **critical gaps** in **stakeholder collaboration**, in the **development of essential capacities**, and how innovative solutions often overlook **user-centering and real-world embedding**.

The transition from fragmented, high-risk innovation cycles to an integrated, sustainable ecosystem requires deliberate, framework-driven development. Based on this analysis, we propose the following strategic imperatives to build a sustainable and resilient future for sports tech innovation:

1. Moving Beyond Silos: The Need for Co-implication and Cooperation

The complexity of the sports tech ecosystem, where multiple stakeholders operate under an everchanging dynamics, often

generates friction and misalignment that negatively impacts their collective potential to deliver impactful and innovation solutions to the market.

To bridge these silos, the ecosystem requires that **all these actors strategically integrate and collaborate along the innovation cycle** (i.e., ideation, validation, development, launching, scaling) according to their specific capabilities, timelines and areas of operation. Innovation ecosystems depend on coordination and governance structures that enable learning and adaptation over time (Canini et al., 2026). In sport technology, sustainable progress requires shifting from isolated product development toward deliberate ecosystem design—where validation pathways, capital deployment, and institutional trust are intentionally aligned.

HEIs are uniquely positioned to evolve beyond their traditional roles as research pipelines and become **key innovation enablers**, leveraging their expertise and credibility. In turn, **specialized R&D partners**, must also act as **functional bridges**, ensuring that Academic rigor, Elite Sport application depth, and Commercial scaling capacity are integrated rather than isolated. In this context, the **polonization of cross-sector Sport Innovation Hubs**, co-implicating essential stakeholders such as entrepreneurs, risk capital, academia, government and industry, should be considered a **priority**, aligned with best practices and existing legal frameworks. In doing so, the promotion of a globally interconnected sports tech ecosystem capable of generating aggregated value would be significantly strengthened.

2. De-Risking Innovation: Blended Finance and Dual-Use Strategies

The "**valley of death**" between prototype development and scalable implementation remains a significant barrier. Sustainable innovation requires **blended financing models** that pair public de-risking (e.g., grants, procurement-driven innovation) with private growth capital. Furthermore, **stakeholders must prioritize "dual-use" strategies**. By intentionally developing technologies that address shared challenges in adjacent sectors — such as healthcare, tactical operations, and occupational health — the ecosystem can access alternative funding sources and powerful scaling mechanisms, reducing reliance on the volatility of the sport market alone.

3. Standardization and Infrastructure: Building Trust and Scalability

The lack of interoperable technology platforms, standardized data protocols, and clear regulatory frameworks erodes trust and hinders adoption. Building a sustainable ecosystem requires **investment in both hard and soft infrastructure**, including robust data governance frameworks. Furthermore, establishing **standardized validation criteria** is essential for ensuring product quality and efficacy. Initiatives such as **STRN's Quality Framework for Sports Technologies** provide a model for mutualized assessment across diverse use cases, enabling more efficient translation and building the trust necessary for scalable impact.

4. Cultivating Interdisciplinary Human Capital and Leadership

Successful sports tech innovation demands talent that **bridges STEM expertise with domain-specific knowledge** (coaching, performance and clinical practice). The ecosystem must foster opportunities for **training and education** through the co-creation and co-design of traditional education programs, continuous professional development initiatives — such as upskilling and reskilling — and mentorship programs built on close connection between academia and industry, aligned with in-demand market needs. Critically, as emphasized by the addition of "Leadership and Vision" as a sixth driver, the ecosystem needs **human-centered leaders** who can unite stakeholders under a shared mission, navigate uncertainty, and model sustainable innovation practices.

A Vision for the Future

The sports tech industry stands at a critical juncture. By adopting these pathways — embracing cross-industry synergies, leveraging blended financial models, prioritizing standardization, and nurturing specialized talent — the sector can move beyond fragmentation. The future of sports tech lies in a cohesive ecosystem that not only strengthens its own innovation pipeline, by intentionally cultivating its key drivers, but also works in concert at its core to transform ingenious ideas into meaningful contributions to advances in health, safety, and human performance worldwide.

At the same time, many of the structural assumptions and proposed mechanisms outlined in this paper require rigorous empirical validation; we hope this work both stimulates deeper research into these open questions and inspires stakeholders across the ecosystem to take deliberate, context-specific action where change is possible and necessary.

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