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Bradley J. Baker  
Temple University, [bradley.baker@temple.edu](mailto:bradley.baker@temple.edu)

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## Impact Analysis of a Virtual Stadium: Measuring Sport in the Metaverse

**Bradley Baker**

*Temple University*

Please send correspondence to: Bradley Baker, [bradley.baker@temple.edu](mailto:bradley.baker@temple.edu)

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There is a long history of literature examining the impact on local communities from building sports stadiums (Bradbury et al., 2022). Inspired by large, routine public subsidies to support construction, researchers have primarily focused on economic impact – the financial benefits that accrue to local residents and businesses. A strong consensus has emerged from this literature that sports stadiums offer, at best, limited economic impact and net of subsidy costs are generally negative (see Bradbury et al. and Matheson, 2019 for recent reviews). A subtheme within this literature has focused on non-pecuniary benefits, such as quality of life, civic pride, and psychic income (Crompton, 2004), with more positive results. Despite strong evidence against positive returns from “investing” public money in stadium subsidies, public financing remains strong, and the median public contribution to stadium construction costs between 1970 and 2020 was 73% (Bradbury et al.).

While the tension around public subsidies of sports stadiums continues, a new phenomenon has emerged that requires considerably lower initial financial outlay – virtual stadiums. Digital Truist Park, a virtual version of the home stadium for Major League Baseball’s Atlanta Braves, officially opened on May 12, 2022 (Bacharach, 2022). Powered by the Unreal Engine, a three-dimensional computer graphics gaming engine from Epic Games that has been deployed in popular games, television shows, and movies (Unreal Engine, n.d.), Digital Truist Park is a photo-realistic replica of the physical venue and surrounding complex. While it is not yet possible to watch live Braves games in Digital Truist Park, Major League Baseball offers games via Oculus Quest (virtual reality goggles) with a subscription to MLB.TV (Ledbetter, 2022). Meanwhile, development of virtual stadiums represents a disruptive innovation that could fundamentally alter the future of sport spectatorship and what it means to attend a game.

While a virtual stadium requires substantial investment – top video games cost \$80 million or more to develop, largely attributable to a need for realistic graphics and world building (Handrahan, 2020) – the costs are at least an order of magnitude lower than required for sports stadiums in the physical world. For example, Truist Park (formerly SunTrust Park) cost \$672 million (including \$300 million in taxpayer funds), while an additional \$400 million was required for the surrounding development (Bradbury, 2022). Moving to virtual stadiums eliminates teams’ reliance on public subsidies for stadium “construction,” while offering a host of features and conveniences enhancing the fan experience. This has led to a spurt

of activity as teams seek strategic advantage as first movers in the metaverse. In addition to Digital Truist Park, other initiatives include Netaverse, a virtual reality viewing experience for Brooklyn Nets games played in the Barclays Center (Cohen, 2022), and development plans between Manchester City FC and Sony subsidiary Hawk-Eye to build a virtual version of Eithad Stadium in the metaverse (Newer, 2022). Table 1 lists virtual stadiums that have recently launched or that are under active development.

**Table 1***Virtual Sports Stadiums and Environments*

Venue / Event	Launch Date	Team	League	Sport	Technology Provider
Nikeland*	November 18, 2021	Nike			Roblox
Netaverse†	January 17, 2022	Brooklyn Nets	National Basketball Association	Basketball	Canon
Digital Truist Park	May 12, 2022	Atlanta Braves	Major League Baseball	Baseball	Surreal Events/Epic Games
NBA Lane	May 13, 2022		National Basketball Association	Basketball	Meta
Monte Carlo F1*	May 27, 2022			Motorsport	The Nemesis
WimbleWorld*	June 29, 2022	Wimbledon/ All England Club		Tennis	Roblox
Etihad Stadium‡	TBA	Manchester City FC	English Premier League	Soccer	Hawk-Eye/Sony
Real Madrid Virtual World‡	TBA	Real Madrid	La Liga	Soccer	Astosch Technology

*Note.* \* Limited time only virtual venue or event that has since closed; † The virtual world in the Netaverse is currently available only to Nets' broadcast partner YES Network and is used for broadcast recreations, while direct fan access remains in development (Baker, 2022); ‡ Announced virtual stadium in development but not yet open to the public.

### Sports in the Metaverse

Computer-generated simulations of real (or imagined) environments, such as Digital Truist Park, form the basis for the *metaverse*, an integrated network of virtual worlds. The term *metaverse*, a portmanteau (a word blending two other words) of the terms *meta* and *universe* (Zyda, 2022), was coined by Neil Stephenson in his science fiction novel *Snow Crash*. Despite a 30-year history, the term exploded into popular discourse only in October 2021 when social media company Facebook rebranded itself as Meta, leading Reuters to name *metaverse* as 2021's top tech buzzword (Culliford et al., 2021).

As the building blocks for the metaverse are put into place, sport represents one of the key pieces to attracting users and conveying the potential promised by science fiction writers and business visionaries (Dib, 2022). Digital stadiums need not conform to limitations of the physical world such as capacity restrictions. Combined with removing the requirement to be physically present, they offer an unmatched consumption opportunity that lowers barriers to fans. Digital sports venues also promise new revenue streams, most obviously from ticket sales but also encompassing sponsorship, in-world advertising, and

digital merchandise for users' avatars<sup>1</sup> (Lemire, 2022). Leading the way into the metaverse may also allow sports teams to capture brand associations as visionary, innovative, or technology-forward organizations, appealing to younger, financially well-off audiences who are increasingly tuning out of the traditional sport product and adopting more fluid fan behaviors (Sports Innovation Lab, 2020).

### **Economic Impact in Virtual Stadiums**

The economic impact of a sport event or facility is the net marginal change in economic activity within a region that can be attributed to the event or facility (Turco & Kelsey, 1992). This includes incremental direct impact – additional spending that occurs because of the stadium – as well as indirect and induced effects as that spending circulates within the economy, causing ripple effects in the form of further increased activity. Indirect effects arise from business-to-business spending to suppliers, while induced effects are generated by household spending of employees whose jobs are supported by economic activity within the supply chain (Demski, 2020). For example, when a fan attends a baseball game and purchases a meal, this triggers additional resupply spending (i.e., restocking hot dogs, buns, beer) and supports the salary of the concession worker, who spends a portion of that income elsewhere within the local economy.

Stadium spending is largely reallocated from other entertainment options, thus marginal economic impact derives only from *new money*, generally defined as money that comes from outside the local market. A stadium in the metaverse lacks a geographic location in the physical world, introducing the question of what it means to create local impact. Fans do not need to travel to attend events at a stadium in the metaverse; while that increases access and opportunity for more fans, it also removes ancillary spending (e.g., hotel stays, meals, retail, other entertainment) in the local market. It remains an open question how best to allocate credit for marginal spending on items such as virtual merchandise in the metaverse. If a fan in London or Seoul purchases an Atlanta Braves jersey in Digital Truist Park, where does the economic impact take place?

### **Measuring the Impact of Virtual Stadiums**

The emergence of virtual stadiums in the metaverse requires rethinking how the impact of stadium development and operations is measured. While impact analysis for physical stadiums has historically focused on local economic impact, this is less central to evaluating virtual stadiums. Development costs are substantially lower, obviating the need for public subsidies. Concurrently, the lack of a physical presence is likely to also reduce willingness to contribute funding from local government officials. Virtual stadiums can accommodate many more visitors than can traditional stadiums; however, as those visitors are not physically present, the possibility of ancillary local spending is greatly curtailed.

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<sup>1</sup>Avatars are digital representations of individuals that may or may not match their owner's features in the physical world. As with physical bodies, avatars may wear branded clothes such as sports jerseys or hats and such merchandise represents a potential revenue stream from licensing intellectual property (i.e., sports team logos).

The financial impact of a new virtual stadium likely looks very different than for a traditional physical stadium. One question that must be addressed is the appropriate level of analysis. Should the economic impact of virtual consumption be credited to the local economy of the sport team or does a move to virtual stadiums signal that teams may transcend geography entirely? To put it more concretely, is Digital Truist Park located in Cobb County, Georgia (home of Truist Park), Fulton County, Georgia (i.e., Atlanta, Georgia), or neither? Defining location factors into economic impact analysis both in identifying locally new money and in establishing patterns of indirect and induced spending as revenue is recirculated through the local economy before leakage out of the region (Demski, 2020).

Another way in which virtual stadiums differ from their physical counterparts is how they generate revenue in the first place. While stadiums like Truist Park generate revenue primarily from ticket sales, in-stadium advertising (including naming rights for the stadium itself), and ancillary sources such as parking and concessions sales (Shonk & Weiner, 2021), the revenue model for virtual stadiums such as Digital Truist Park will fundamentally differ. Ticket sales for admission and in-stadium advertising have clear parallels, although the prices commanded are likely substantially different. Additionally, attendees at a game held in Digital Truist Park are unlikely to pay to park a car or drink an overpriced beer. The cost for a family of four to attend a Braves game at Truist Park in 2022, excluding tickets, was \$116.78 (Hartweg, 2022), revenue that disappears when games occur in a virtual stadium. Yet, virtual events lend themselves to virtual merchandise sales. A Lil Nas X (American rapper and social media personality) concert on Roblox (an online virtual world that features community-created games and events) in December 2020 reportedly led to nearly \$10 million in digital merchandise sales (Dredge, 2021).

Virtual venues in the metaverse accelerate a move toward virtual goods. Much as ticket stubs have become a collectible, teams could automatically generate non-fungible tokens (NFTs) of pivotal moments and game highlights and give them to all virtual attendees. These NFTs represent tradable collectibles that can be sold on a blockchain and provide extra benefit from game attendance and enhance fan engagement (Baker et al., 2022). As the metaverse evolves from isolated virtual worlds to a truly interconnected environment, virtual apparel (e.g., a branded baseball cap or jersey) that fans can incorporate into their avatars gain value and cachet. As in the physical world, fans will want to demonstrate their attachment to their favorite team in the metaverse, requiring purchasing virtual goods.

Assigning geographic responsibility for economic activity has implications beyond merely assessing local economic impact. Tax revenues are typically collected based on where economic activity takes place. When sport takes place in the metaverse, it becomes unclear which local governments hold jurisdiction or can impose taxes on the revenue generated. This impacts not only sport organizations but also individual athletes. Most U.S. states with major professional sports teams impose taxes on non-resident athletes (and coaches, athletic trainers, and other team personnel) in what is colloquially known as a *jock tax*. When virtual stadiums merely replicate games played in traditional physical stadiums, there is minimal impact on local tax revenues; however, if sport shifts to virtual play and teams no longer travel, the ability to tax members of visiting teams also evaporates.

## Non-Economic Impact

Beyond how virtual stadiums replace or alter traditional consumption and generate revenue or economic impact, there are an almost endless number of additional topics that require consideration and research. Among these topics are how best to support social interactions between fans in a virtual stadium, design of truly immersive environments, personalizing spectator experiences, adequate technology infrastructure and equitable access, licensing rights, integrity of the game, and cybersecurity. The remainder of this section briefly reviews these non-economic topics that require careful planning and applied research to guide managerial practice.

Sport consumption is an inherently social activity. Watching sport fulfills a need for interpersonal connection and provides opportunity to interact with other spectators (Funk et al., 2009). Any move to spectating in virtual stadiums requires understanding how best to support social interactions including between friends spectating together, experiencing the sense of belonging from being part of a mass audience, and serendipitous encounters with strangers, to replicate the conventional stadium experience.

Current virtual worlds focus primarily on visual environment building and haptic (touch) controls. Yet a truly immersive experience requires attention to other senses as well, particularly auditory (sound) stimuli. Three-dimensional spatial audio represents a new generation of technology beyond two-channel stereophony or multi-channel surround sound (Herre et al., 2015). Replicating a complete acoustic environment – or synthesizing realistic artificial acoustic environments – requires sophisticated approaches to create a sound field capturing environmental cues and reacting dynamically to users' movements.

Within a physical stadium, the fan experience is relatively homogeneous, at least for patrons in the same part of the venue. That need not be true in a virtual stadium. Just as *virtual replacement technology* allows sport organizations to virtually replace in-stadium signage displayed during game broadcasts and geo-target globally distributed audiences (Ratten & Thompson, 2021), virtual stadiums will support highly personalized advertising displays.

The fan experience will also vary depending on technology access and infrastructure. How one attends a game in a virtual stadium – via Internet browser, virtual reality goggles, or fully immersive multi-sensory station – will dramatically impact the fan experience. Bandwidth limitations may remove portions of the virtual experience, resulting in unequal access and reproducing existing disparities from the physical world in the virtual (Greene, 2021). In-person attendance at major sporting events can be cost-prohibitive, and while virtual stadiums could relax capacity constraints and reduce cost, the technology requirements are likely to keep attendance out of reach of much of the world.

Adequate bandwidth to convey a virtual environment is also necessary to ensure synchronization and reduce latency or lag. This is vital when viewing sport together with other fans who may be geographically dispersed. Synchronization is also critical when supporting a growing area in sport consumption – real-time in-game betting (Killick & Griffiths, 2021). If game events in virtual stadiums are not experienced at essentially the same time for all viewers, then real-time betting breaks down (Rodenberg et al., 2015).

Moving sport to the metaverse and virtual stadiums introduces unresolved questions regarding the impact on existing and future licensing and broadcasting rights agreements. The extent to which licensing



in the metaverse is covered by traditional agreements or should be carved out into stand-alone deals remains to be seen. Additional questions swirl around name, image, and likeness rights of athletes (Kunkel et al., 2021) and the rights of individuals over their digital depictions or persona (Crusto, 2022). Already a hot topic within intellectual property law, sport in virtual stadiums adds a novel wrinkle requiring additional expertise in sports law.

Shifting to digital-first sport delivery affects many individuals currently employed in sports organizations. While a virtual stadium may require an expansion of highly skilled designers and computer programmers, much of that work may need to be performed once and only modified or maintained over time. Decreased emphasis on attendance in physical stadiums will remove the need for hundreds of (mostly part-time and low pay) jobs such as ushers, concession sellers, and parking lot attendants. While an essential part of game-day operations, individuals employed in these roles are frequently outside formal sports organizations and their positions will be among the first eliminated. The disruptive impact of virtual sports will be far-reaching, especially as improvements in artificial intelligence allow ever-increasing levels of automation.

Integrity of the game is an evergreen topic in sport as competition is predicated on the ideal that every competitor is provided a fair opportunity to excel and succeed. As has been seen in esports contexts, virtual environments introduce new opportunities for malevolent actors to cheat. While in traditional sports, cheating typically takes the form of illegitimate physical enhancement (e.g., steroid use by athletes) or in-game behaviors (e.g., point shaving or throwing games), in virtual environments the very nature of the world and physical laws can be altered, at times in ways that are largely undetectable. Virtual stadiums, particularly if used to host sport and not merely to reproduce games originally conducted in a physical venue, require a high degree of cybersecurity protection.

Cybersecurity protection is also required to maintain ownership and control of digital assets. Fans who purchase virtual merchandise require assurance that their digital goods cannot be stolen. Ensuring the authenticity of virtual goods is also essential to maintaining value based on (artificial) scarcity and excludability. NFTs and blockchain technology are already entering the sports industry as ways to track ownership and verify authenticity (Baker et al., 2022), a trend that will accelerate with growth in virtual stadiums and sports in the metaverse.

## Conclusion

As sports teams enter the metaverse through launching virtual versions of their home stadiums, there is a pressing need to reimagine the stadium experience and how virtual stadiums differ from their physical counterparts. This includes both traditional measures of stadium performance, centered around local economic impact, and novel challenges that apply only in the digital realm. Virtual stadiums allow teams to transcend geography when competing for fluid fans, yet open questions remain around how to provide the best in-game fan experience, equitable access, licensing rights to sports data and players' digital representations, and maintaining integrity of the game in a digital sport environment. This review establishes a foundation for crucial conversations that can shape future research and managerial practice amidst an emerging trend in the sport industry.

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