

# Architecture as a driver for the athletic performance enhancement of professional swimmers at the University of Pretoria, TuksSport

by Ruan Ras - 04462794



Figure 1: Spectator's view at the TuksAquatics Centre (Author, 2021)



## Declaration

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

Student name and signature:

**Ruan Ras**

A handwritten signature in black ink, appearing to read 'Ruan Ras', with a stylized flourish at the end.





Figure 2. Swimming at the TuksAquatics Centre (Author, 2021)



# Project Summary

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**Course Leader:** Prof. Arthur Barker

**Research field:** Memory, legacy and identity

**Programmes:**

Olympic standard aquatics sports training and competition venue with supporting facilities

Pubic recreational swimming pool and food court

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**Client:**

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Rocco Meiring, Head of TuksAquatics, University of Pretoria

**Key words:**

Sports architecture

Athletic performance enhancement

Evidence based design





Figure 3: Swimming at the TuksAquatics Centre (Author, 2021)



# Abstract

Sports architecture, through the standardisation and the intense control held by sports authorities over the past century, has experienced a change in identity: from a tool for social movements to a shell for commercial institutions (Payandi, 2013: 5-6). The commercialisation of sport has resulted in sport as an industry - and as a result, its architecture - having the main objective of economic gain, as opposed to the initial goal of sport to “better the individual” (Tao, 2017: 314). Architects should, therefore, revert back to this original objective, if they aim to design sports architecture that facilitates the enhancement of athletic performance for professional athletes as the main user-group of this project.

Contemporary sports architecture has evolved into a unified “international-style” of sports venue design (Payandi, 2013: 6-7), dislocated from its context and favouring *functionality* as the main design driver. The *experience* of the user or athlete is often ignored during the design process resulting in the architect only responding to some aspects of the professional athlete as their main user group. If the architecture carries any potential of “bettering the individual” (Tao, 2017: 314), through athletic performance enhancement specifically, the designer must spatially respond to the athlete as a whole - physically, emotionally, mentally and spiritually (Reynaldi et. al, 2019: 70). By responding to an athlete’s psyche (*experiential*) and their physical condition (*functional*), the architecture will be able to maximise its performance enhancement potential. In this mini-dissertation, the TuksAquatics Centre is used as a prototype site to investigate the impact that architecture can have on sport and its athletes.



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## Part 1:

In this chapter, the research questions and objectives explored in this mini-dissertation are explained. A literature review aids in gaining a better understanding of the topic at hand, that is: sports architecture and its impact on the user and athlete. Through the literature review, a general, urban and architectural issue is identified and viewed in terms of the identified site: The TuksAquatics Centre at the University of Pretoria's Hillcrest Sports Campus. The state of current sports architecture is further analysed to determine the site's positioning in the continuum of local sports architecture. Lastly, a methodology of evidence-based design strategies paves the way for the following chapters.

### Introduction

The need for sport largely roots from its ability to fulfill athletes' needs physically, emotionally, mentally and spiritually. In order for an athlete's needs to be fulfilled through sport, certain infrastructure is required to provide a 'place' for this activity to occur (Reynaldi et. al, 2019: 70). This infrastructure needs to be designed to accommodate the unique needs of athletes. David Winner implies an inherent relationship between the nature of *sport* and that of *architecture*. In his book, *Brilliant Orange: The Neurotic Genius of Dutch Soccer*, he describes sport as a "kind of architecture on the field" (Winner, 2008: 46-47). He expands on this by connecting athletes' movements to a form of spatial organisation (Cleary, 2017) (Figure 4). Space and movement are interlinked. These movements, whether they occur in informal play areas or in a large stadium, are all, in one way or another, a form of spatial expression (Cleary, 2017). Each movement takes place within a physical frame; be it markings in the sand or painted score-lines on a well-maintained pitch. The frame transforms general 'space' into 'place' (Cleary, 2017).

Sports architecture as 'places of activity' involve two factors: the frame (figure 5) and the performance (figure 6). The *frame* describes the physical layout and structure of the playing field, while the *performance* speaks of the actual movements and actions of users in the space (Cleary, 2017). Sports design therefore has an effect not only on the physical structure of a facility, but also on the performance of the athletes using it - the *frame* impacts the *performance*. Consequently, architecture plays a vital role in how a sport is played. However, functionality has become favoured in sports design (Payandi, 2013: 27-28) and the experience of the athlete is often omitted during the design process. This has resulted in architects not maximising the athletic performance enhancing potential of sports design.

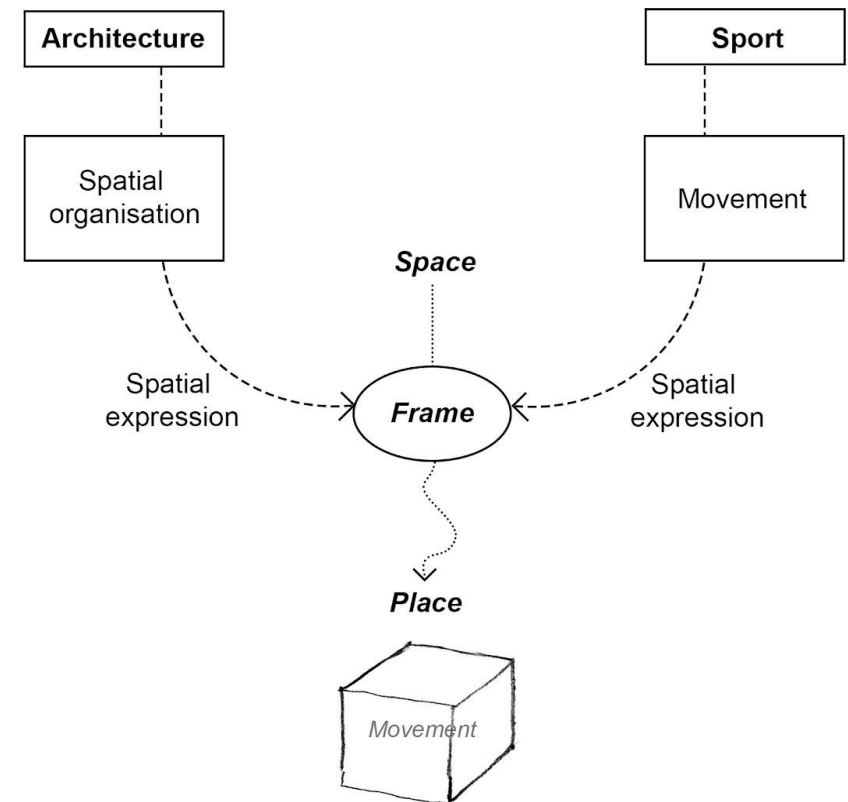


Figure 4: Relationship between sport and architecture (Author, 2021).



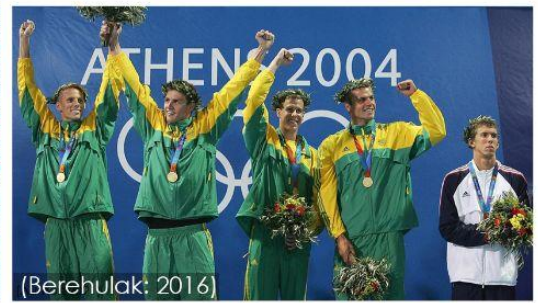


Figure 5: Examples of frames in the sport of swimming.

Figure 6: Examples of performances in the sport of swimming.



## Research Questions and Objectives

In this dissertation I aim to identify spatial and functional drivers that aid in physically and psychologically enhancing athletic performance by determining a prototype for professional-athlete-centred sports architecture in the local context, specifically related to professional swimmers at TuksSport at the University of Pretoria.

The following questions arise:

1. How is current sports architecture, for professional athletes specifically, failing the athletes who use it?
2. How can the design of sports architecture be improved to benefit and enhance the athletic performance of the professional athletes it serves?



© University of Pretoria *Figure 7: Currently failing sports facilities (O'Bryan, 2021).*





Figure 8: The current condition of the Tuks Aquatics Centre (Schlechter, 2021).



## Literature Review

The *frame* discussed earlier presently takes the form of a variety of architectural typologies for sports facilities - each type serving a particular *function* and *user group*. The functions are divided into various scales of intervention ranging from national-scale to school-scale facilities (Reynaldi et. al, 2019: 71). The users correlate to the levels of sports participation, ranging from *professional-level* participation to *recreational* participation to *non-participation* (Deleen et. al, 2018).

Under closer investigation, these sports architecture typologies are formed around well-defined 'boundaries'. These boundaries regulate how the sport is played (Cleary, 2017). Regulation authorities and sporting associations typically set standards and requirements for the design of facilities in each specific sporting code. This gives architects a relatively good reference when designing sports facilities. However, there are few building typologies or standards that regulate the optimum training or competition environments outside of the physical dimensions of the field of play; for example, the intermediate spaces that athletes interact with on the lead-up to their race or match, like the marshalling room where athletes report before their race (Figure 9).

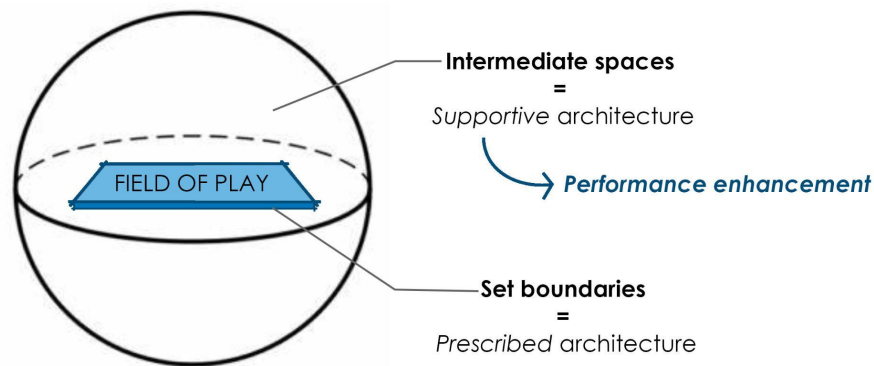


Figure 9: Intermediate spaces in sports architecture (Author, 2021).

Most sporting histories follow the general trend of the transformation of *informality* and *improvisation* into *standardisation* and *specificity* (Cleary, 2017). As the competitive nature of sport, in contrast to basic 'play', or other practices increased, the need to standardise playing fields grew to ensure fairness in competition. Earlier playing fields, which lacked specificity, allowed early sports architecture to be adapted and altered as needed by designers. Similarly, early games could be adapted to suit a variety of spaces, depending on the type of space available to athletes (Cleary, 2017). However, modern sport requires much more standardised settings (Figure 10). Most physical court or field dimensions became fully standardised in the 1920s (Cleary, 2017). Various sporting authorities emerged as a result of the need to govern this standardisation and fair practice in sport.

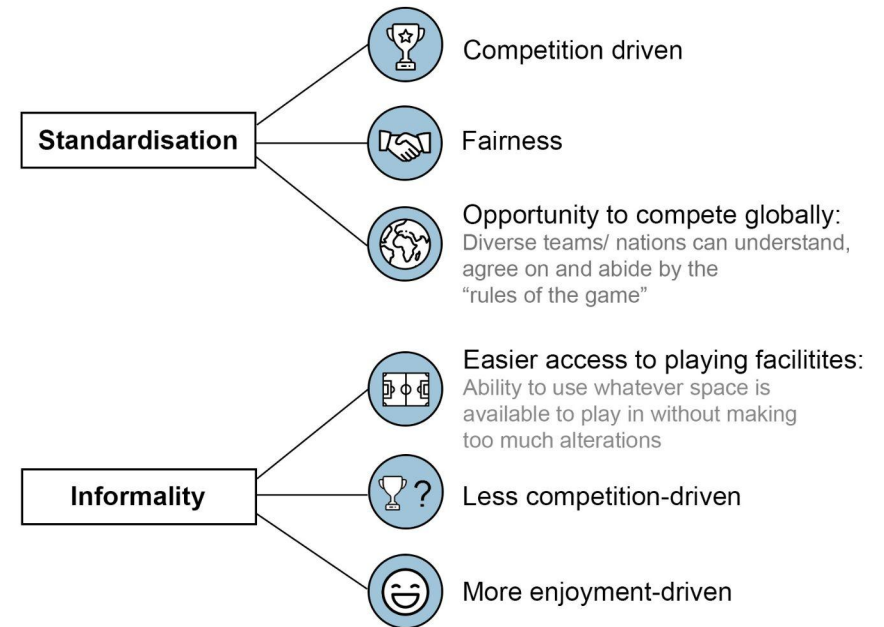


Figure 10: Standardised sport vs. Informal sport (Author, 2021).



As a **general issue**, sports architecture, through this standardisation and the intense control held by sports authorities over the past century, has experienced a change in identity: from a tool for social movements to a shell for commercial institutions (Payandi, 2013: 5-6) (figure 11). The commercialisation of sport has resulted in sport as an industry - and as a result, its architecture - having the main objective of economic gain, as opposed to the initial goal of sport to “better the individual” (Tao, 2017: 314). Architects should, therefore, revert back to this original objective (figure 12), if they aim to design sports architecture that facilitates the enhancement of athletic performance for professional athletes as the main user-group of this project.

In terms of the **urban issue**, contemporary sports architecture, also through the process of standardisation, has evolved into a unified “international-style” of sports venue design (Payandi, 2013: 6-7). This disconnect from context and global approach to design, has resulted in sports architecture becoming dislocated from its urban environment and from the people who live, work, train and play there. Also, over the past century, notions of nationalism, militarism and totalitarianism have skewed the role of sports architecture in the city (Payandi, 2013: 28): resulting in ‘sports architecture as monument’.

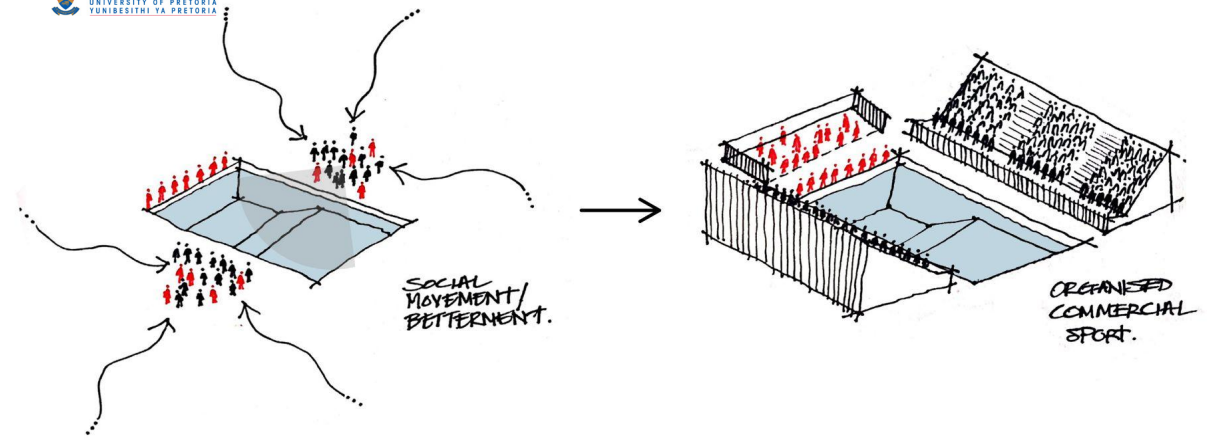


Figure 11: From a social tool to a commercial entity (Author, 2021).

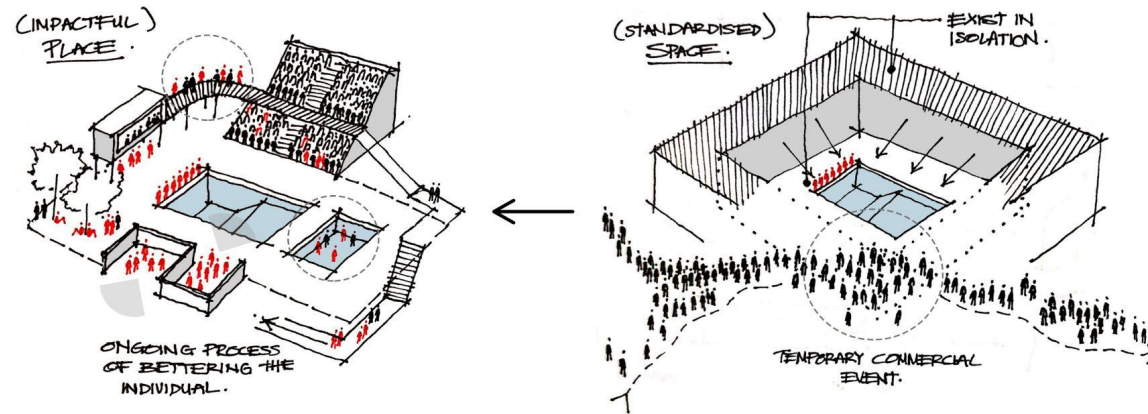


Figure 12: Return to an architecture to improve the individual (Author, 2021).

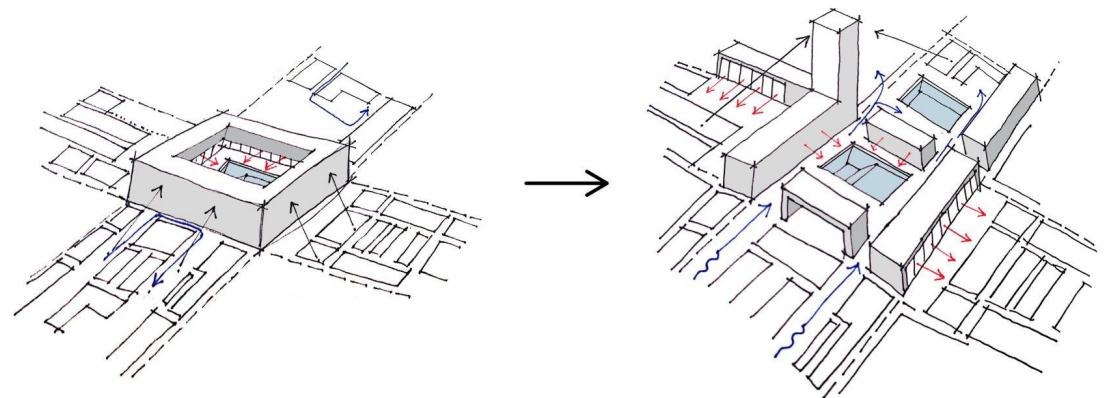


Figure 13: Reconnecting sports architecture to the surrounding fabric (Author, 2021).

Fortunately, current sports architects have started to move away from this idea of monumentalisation and have started to look to sports architecture as “modern cathedrals” in the city: places for “mass-pilgrimage” and “representative of hope” (Payandi, 2013: 27-28). For example, the 2012 London Olympics employed the slogan of “architecture for humanity” in an attempt to use the international sporting event and the *frames* which housed this event to make a positive contribution to the local people, economy and environment. Locally, these issues of monumental sports architecture that are disconnected from their urban environments can be generally seen in the stadiums constructed for the 2010 World Cup. The world-class stadiums remain heavily underused due to their *design’s* lack of effective urban integration (Imray, 2012). Stadiums as landmark urban features may have many benefits, but if not correctly integrated into the urban fabric, they can often dominate and negatively impact the direct surroundings (Twardowski, 2018: 54). The design needs to respond to the periodicity of sports events (Figure 14).

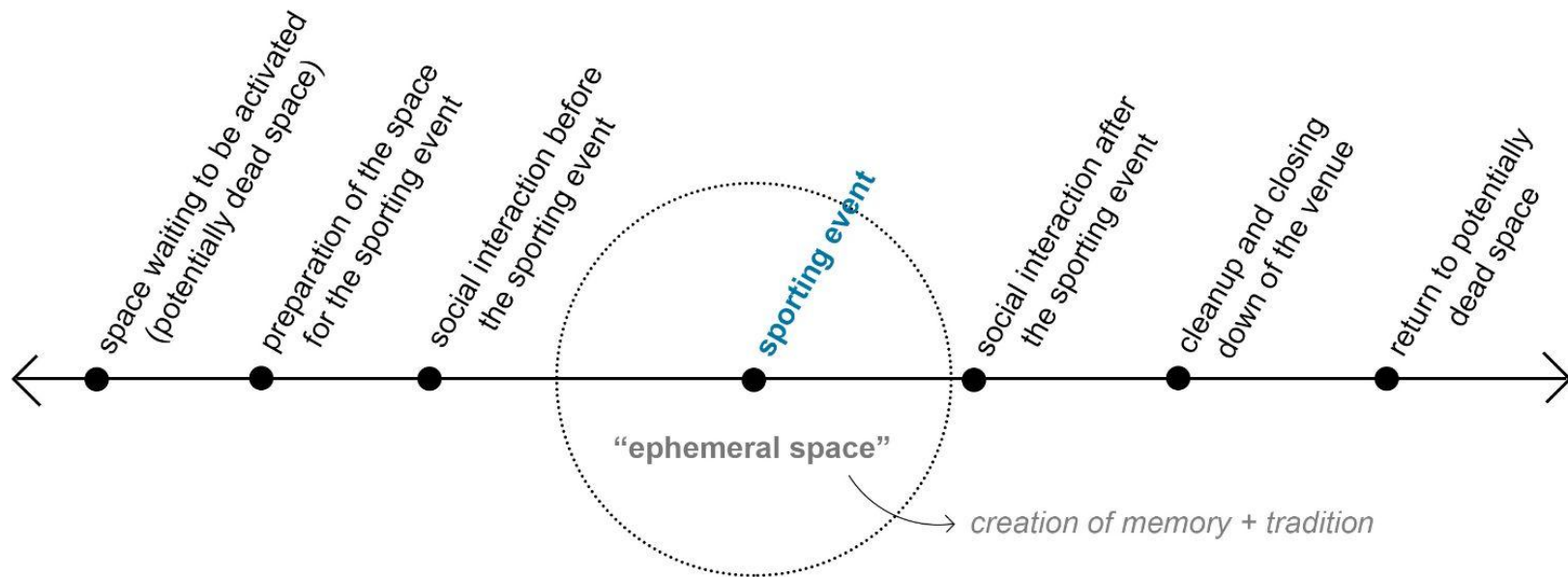


Figure 14: Periodicity in sports architecture (Author, 2021).





Figure 15: Aerial view of the TuksAquatics Centre (Schlechter, 2021).



Figure 16: Aerial view of TUKS swimmers training (Schlechter, 2021).



Locally, rapidly decaying local swimming training and competitions facilities has become widely evident in South Africa (Crossley, 2021; Scheepers, 2021; O'Bryan, 2021) (figure 17). With no users and activity, even the 'memory of place' is eventually lost (figure 18). Disconnected and unsustainable design solutions mean that the sports venues will be unable to assist our professional athletes - detracting from the athletic performance enhancement potential of sports architecture.



Figure 17: Rapidly decaying local sports architecture.



(Citizens of Mzansi: 2021)



(Forgotten in Africa: 2021)



Figure 18: Abandonment and loss of memory.



The selected site is at the TuksAquatics Centre of the University of Pretoria, Hillcrest Sports Campus, built during the 1970s (figure 19). The campus and Aquatics Centre specifically, currently accommodate the training and competition of various national and international-level athletes and swimmers, making it the ideal environment to design architecture that enhances athletic performance. Architecture on the sports campus can be located as part of the continuum of sports architecture by comparing it to the evolution of the stadium (Payandi, 2013: 37-44) as the most iconic form of sports design. The general architectural trend seen on campus exists between the basic and the multifunctional stadium (Figure 20).

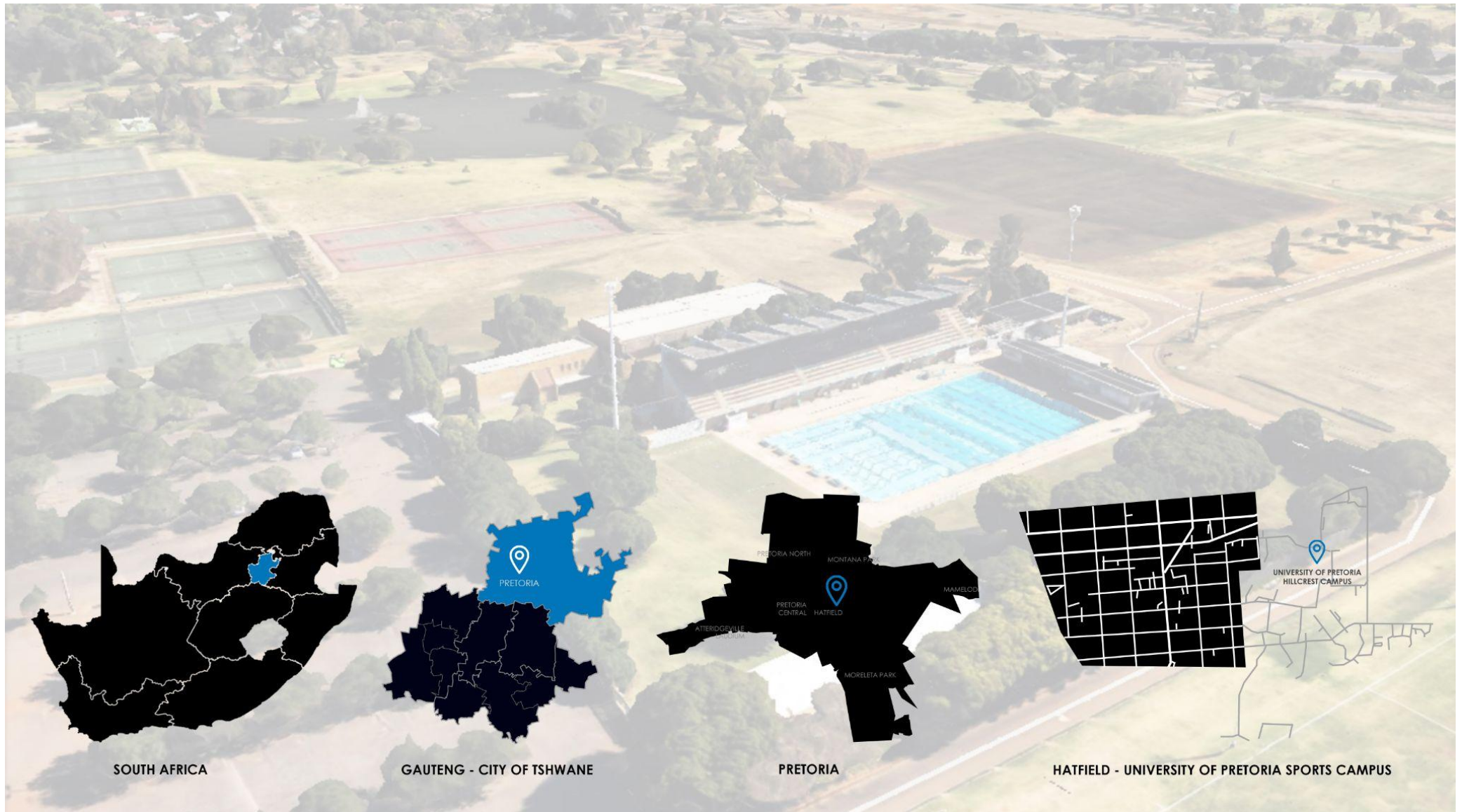


Figure 19: Site location (Based on GoogleEarth, 2021).



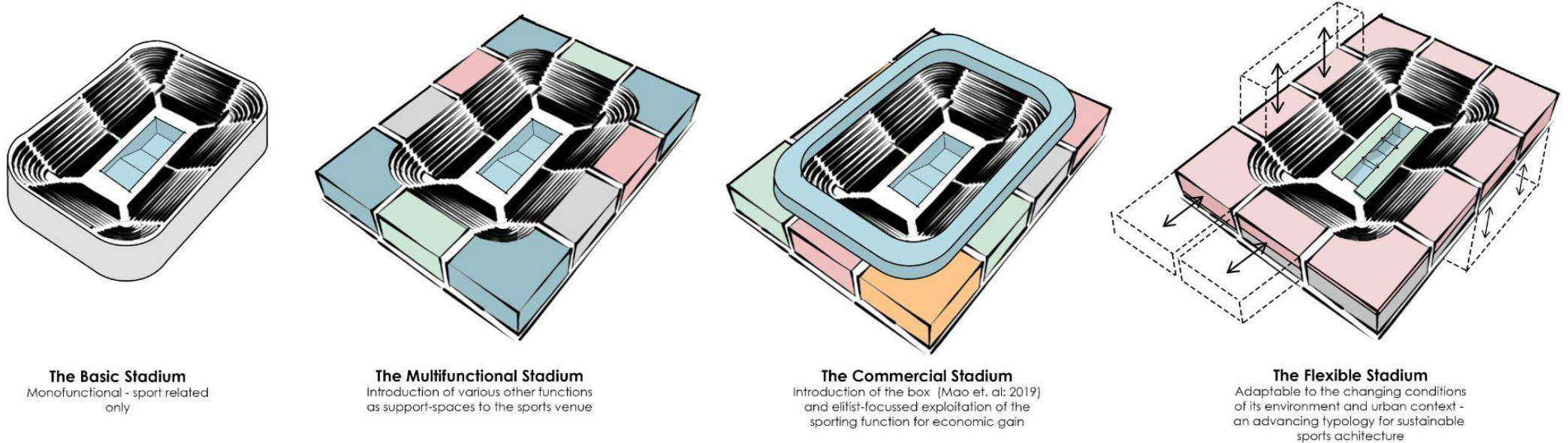


Figure 20: Evolution of the stadium (Author, 2021).

Bernard Tschumi conceptualises architecture as “the activation of a space through the movement of bodies” (Tschumi, 1995). However, sports spaces on the campus depend on their function to keep them alive. As soon as function, in the form of sporting events, ceases, so too does the activity on the campus. The temporality of sports architecture must, therefore, be addressed. The architecture on the Hillcrest campus must borrow from newer notions of stadium design: *The flexible stadium* (Payandi, 2013: 44). Existing principles of responsible urban design, public integration, sustainable design and adaptable architecture can be used to provide lasting training and competition venues that support our local athletes (Twardowski, 2018: 54).

Past stadium-designs have proven unsuccessful in this regard, with Sheard comparing them to “inhospitable concrete bowls of the twentieth century” (Sheard, 2001: p.1-18). However, recent designs of Olympic stadiums have begun to employ *adaptable* and *multifunctional* design principles to enhance their sustainability (Hudec et. al, 2016: 1393-1397). For example, the IOC insists that its sporting venues are designed with strict environmental sensitivity in mind (Sheard, 2001: 60-67). Issues that are promoted by the IOC include: environmentally friendly construction materials, efficient energy usage and waste management, minimising building maintenance and designing contextually sensitive buildings that are responsibly inserted into existing urban structures with the aim of improving and uplifting these structures (Twardowski, 2018: 54).

Furthermore, in terms of the architectural issue, due to the commercialisation of sport and through the process of standardisation in sports environments, functionality has become favoured in sports design. The experience of the user or athlete is often ignored during the design process resulting in the architect only responding to some aspects of the professional athlete as their main user group. If the architecture carries any potential of “bettering the individual” (Tao, 2017: 314), through athletic performance enhancement specifically, the designer must spatially respond to the athlete as a whole - physically, emotionally, mentally and spiritually (Reynaldi et. al, 2019: 70) (figure 21). By responding to an athlete’s psyche (*experiential*) and their physical condition (*functional*), the architecture will be able to maximise its performance enhancement potential.

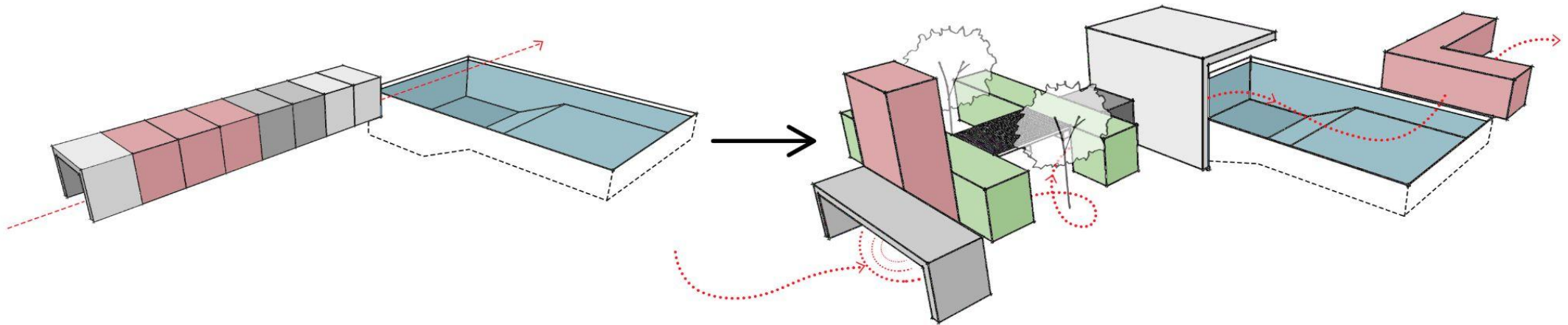


Figure 21: Injecting 'experiences' into functional architecture (Author, 2021).



## Current condition of sports architecture

The physical space of the typical sporting venue can be organized into *levels of interest* (Figure 22). Woodbine describes these levels as a series of layers or circles expanding outwards from the playing field (Cleary, 2017). Each level of interest induces a different design approach to suit the varying users and their unique functional and experiential needs. These levels of interest can be further subdivided into sub-levels like *class*. The separation of class in spectator spaces dates back to as far as the ancient Colosseum in Rome, where seats were divided into five zones based on class and prestige (Mao et. al, 2019).

Many present-day sporting arenas also separate spectator spaces based on levels of class: from the basic spectator seat (open, shared and grouped according to its distance from the playing field) to the *boxes* for the more privileged sports enthusiasts (exclusive viewing rooms with added features like bar areas, better views and private ablutions). Since the 1990s there has been an increasing number of spectator boxes in NBA arenas (Mao et. al, 2019). These commercialised sports centres target elite groups to increase the profitability of the venue.

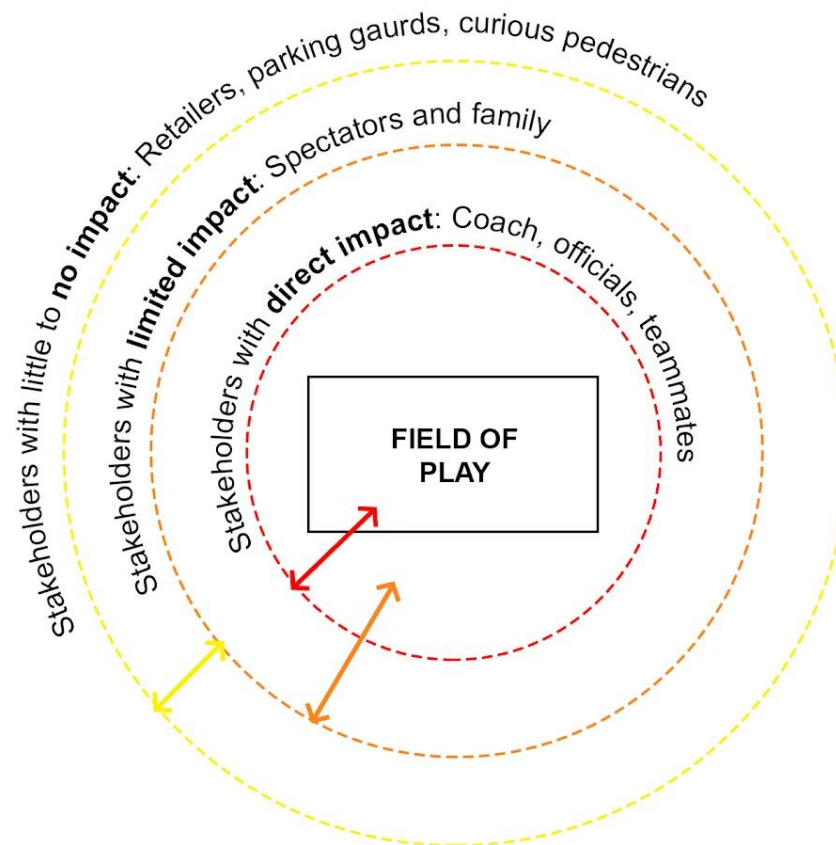


Figure 22: Injecting 'experiences' into functional architecture (Author, 2021).

However, one can design for more inclusive ways of ensuring the economic feasibility of sports facilities (Figure 23). For example, in 2010 at the Guangzhou Asian Games, nearly 20 years after the introduction of the box in NBA stadiums, China fully adopted the United State’s commercialised model of the box. Boxes became not only a platform for sports entertainment, but also for a variety of performing arts. Its multifunctionality improved its utilisation rates, in turn, increasing its profitability (Mao et. al, 2019). In this way, designing adaptable and multifunctional spaces can enhance the usability and sustainability of the architecture, making it more economically viable.

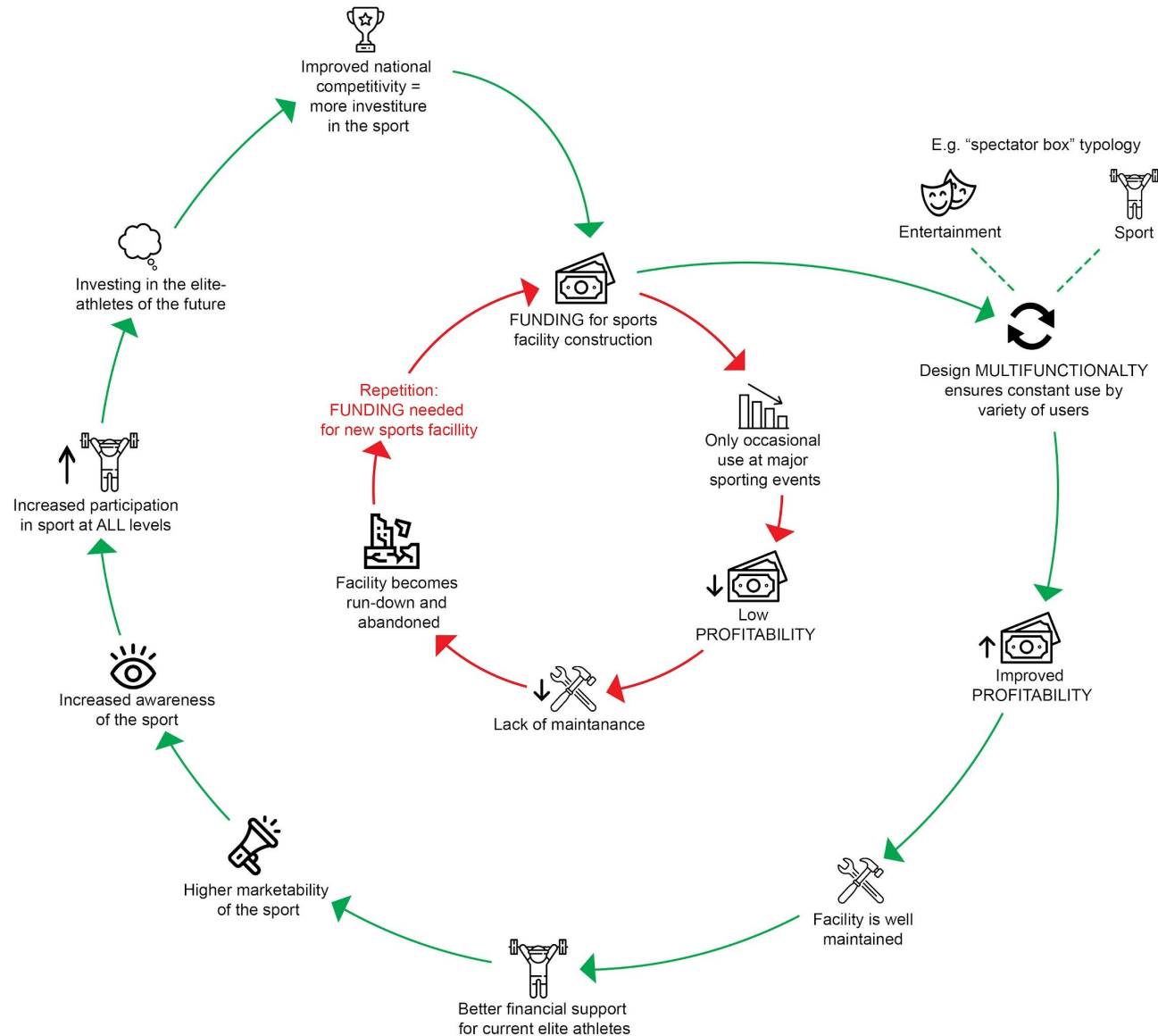


Figure 23: Economic feasibility in sports architecture (Author, 2021).



## Methodology

As a competitive swimmer myself, I am also a potential user of the architectural intervention: Therefore I am borrowing from my own experiences (which are *subjective*) as well as theory (which is *objective*) to investigate the athletic performance-enhancing potential of architecture. The research methodology responds to the holistic approach needed for athlete-centred design; thus, responding to the athlete's psychological and physiological conditions to enhance the functionality and experience of sports-related spaces. This is done through interpretivist qualitative studies that are based on evidence-based design principles (figure 18). Research will be done in accordance with all required ethical considerations such as anonymity and voluntary participation in studies and interviews.

According to psychology professor Irving Weiner, environmental psychology can affect one's mood and behaviour (Moses, 2012) which, in turn, affects one's physiological condition (Deasy, 1990: 112). Environmental psychology and architecture are connected by means of 'evidence based design'. Evidence-based design can thus be used to respond to the psychological and physical stressors experienced by elite athletes. In this way, architecture is used as a holistic spatial solution. Four key aspects from Malkin's book, *A Visual Reference to Evidence-Based Design* (2008), have been identified for the effective use of evidence-based principles in architecture. These form the basis of my research methodology (figure 24):

- Contextually driven design responses related to the chosen site, the existing buildings and the proposed campus framework,
- Theory driven design through the literature review and investigation of relevant architectural theories to find confluences between sports psychology, environmental psychology and architecture,
- Critical design responses where theory is translated into spatial interventions to respond to the *experiential* quality that is needed in sports-related design, as well as
- Collaboration with the users in the form of interviews with athletes and coaches (see Appendix A).

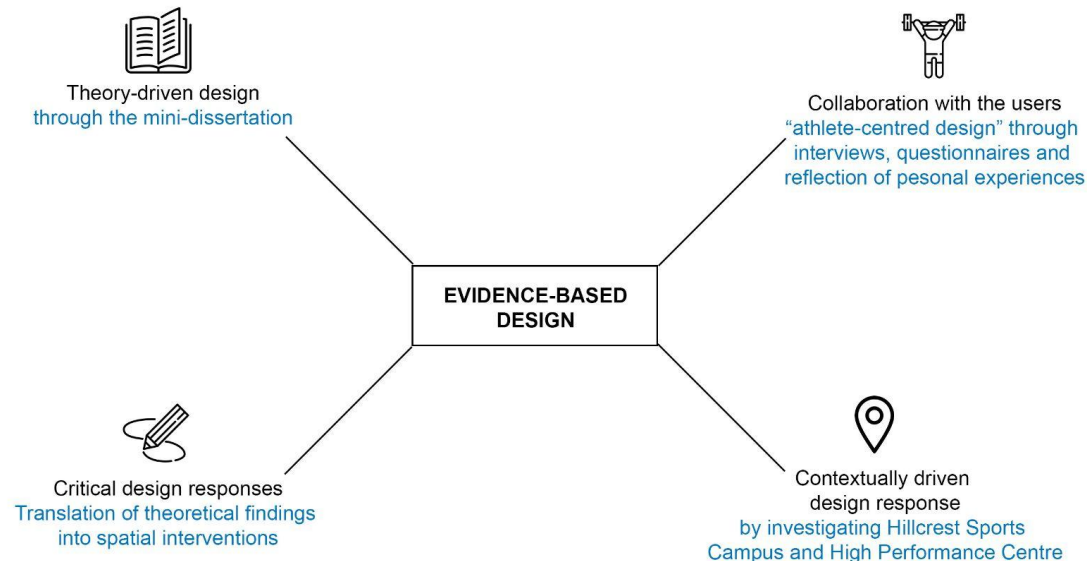


Figure 24: Key aspects for the effective use of evidence-based design principles in architecture (Adapted from Malkin, 2008).

## Evidence Based Design and Sports Psychology

Evidence-based design has been widely used in research pertaining to “healing environments” in *hospitals*. The design of “healing environments” is to use neuroscience to benefit from the effect of “psychologically supportive” spaces on the immune system of patients (Malkin, 2008: 2). However, evidence-based design research goes further than merely healing environments. It is an investigation of how external stressors on users can be reduced, how the operational efficiency of a building can improve the quality of the service it accommodates as well as improving the safety of its users (Malkin, 2008: 2). Evidence-based design can thus be taken further than merely hospital design and can be incorporated into other programs as well (Figure 26).

Cohn and Gullu (2020) identify a variety of mental stressors experienced by athletes that could negatively impact their performance (figure 25). These stressors include: a lack of focus, lack of confidence, anxiety, not coping with external factors, feelings of discouragement when injuries occur as well as strained athlete-coach relationships. The architecture must employ evidence-based design principles that resolve these issues, such as:

- Noise reduction in spaces through material choices and zoning of programs to enhance focus (HMC, n.d. and Malkin, 2008: 8),
- Improved natural lighting to keep athlete’s minds alert (HMC, n.d. and Malkin, 2008: 8),
- Flexible spaces to give athletes control over their environment to induce feelings of confidence (Winkel et. al, 1986 in Malkin, 2008: 8),
- Removing environmental stressors such as designing shelter from weather (Malkin, 2008: 9),
- Injecting nature into the design to induce calmness in certain spaces where athletes may feel most anxious (Ulrich, 1984 in Malkin, 2008: 8),
- Designing for social spaces that encourage healthy interaction and support between teammates (Kiecolt-Glaser, 1998 in Malkin, 2008: 8),
- Multisensory design principles that act as positive distractions to avoid pre-race anxiety (Taylor, 1997 in Malkin, 2008: 9),
- Enhancing sensory experiences in certain spaces to induce energy and excitement, for example, before a race (Malkin, 2008: 9), and
- General sustainable design principles that enhance general health such as sufficient ventilation and easy maintenance of spaces to prevent mould and other health hazards.



Figure 25: Stressors experienced by athletes pre-race (Chase, 2016).



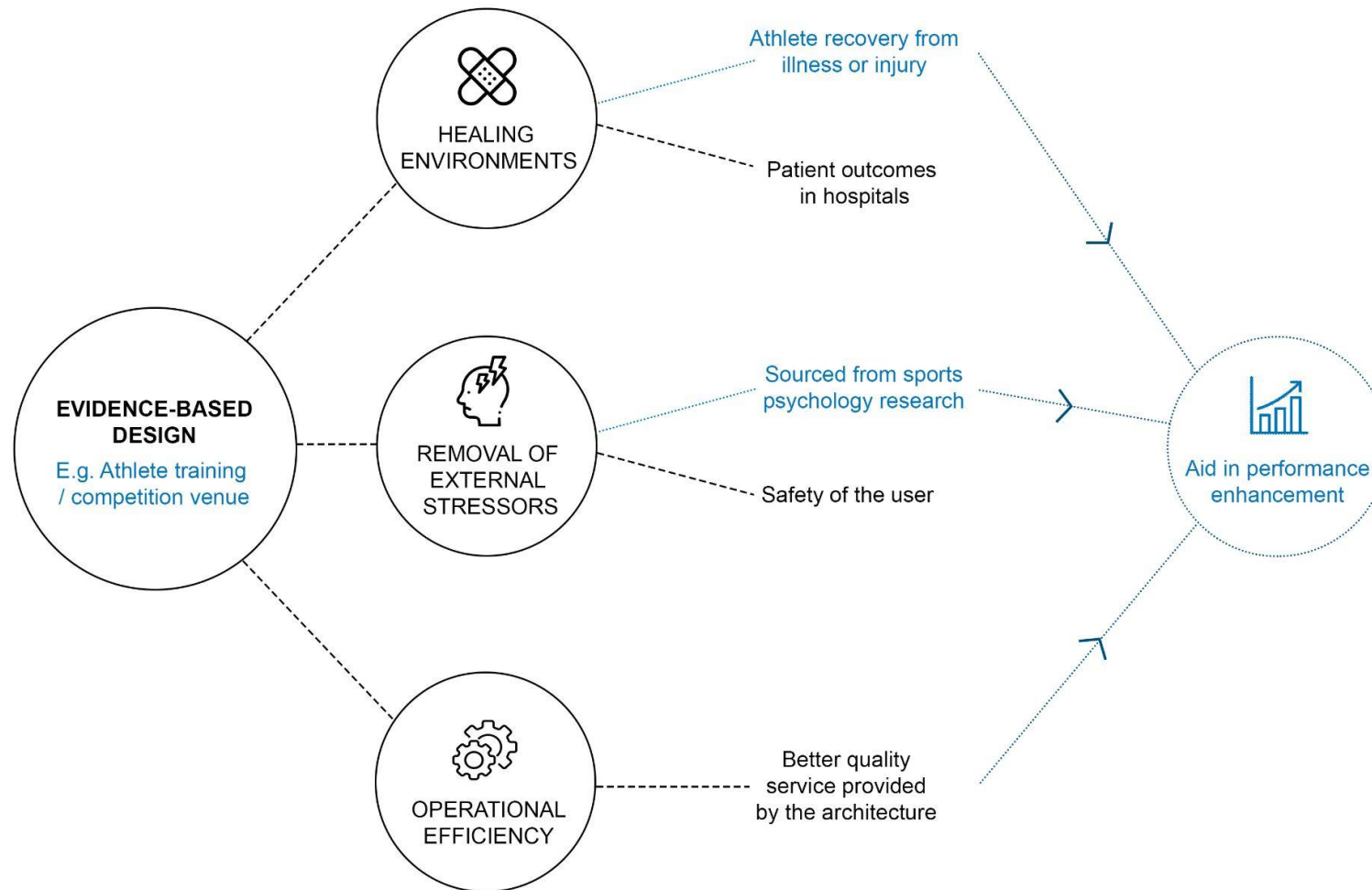


Figure 26: Relevance of evidence-based design for athletic performance enhancement (Adapted from Malkin, 2008).  
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## Design for Athletes' Physiology

Furthermore, the physical principles of athletic performance enhancement will also be translated spatially, so functionality is not omitted as it does carry value, but no longer exists in isolation (figure 27). In terms of improving the physical condition of an athlete through design interventions, one must first look at the most common physical stressors experienced by competitive athletes. One very common example is that of injury. Firstly, the design should promote injury prevention through ergonomic design (Ju, 2016: 2). Secondly, the appropriate use of materials becomes vital, for example, the material used to construct the floor on a running track versus that of a weights room: running as a high impact exercise requires a softer floor finish, like astroturf, to reduce the impact on athletes' joints, while the floor finish in weights rooms should be considerably harder to enhance stability while lifting heavy weights.

Furthermore, the design should enhance the effectiveness of athletes' physical activities in their training environments. Reynaldi, Kridarso and Iskandar (2019) promote 'hi-tech architecture' as a major design driver for modern-day sports architecture that could aid in achieving this. They do not make reference here to the hi-tech architectural movement of the 1970s. Rather they encourage architecture that involves advanced technology to improve the building's functioning. Including technology as a key component in sports-related design can significantly impact the overall social, cultural and physical functioning of athletes' training and competition environments (Tao, 2017: 312). A variety of factors are influenced, including designing safer spaces for athletes to train and compete in (Mainetti et. al, 2016: 1).

High-Tech architecture does, however, enhance the adaptability of a building (Reynaldi et. al, 2019: 71). Adaptability in architecture defines the structure's ability to take on a new function, program or purpose (Hudec et. al, 2016: 1394). Similar to adaptable architectural structures, athletes also adapt to the actions of their opponents or teammates - changing their movements, spatial layout on the field or position on the court (Cleary, 2017). Adaptation lies at the core of both good sport and good architecture. For example, multifunctional and adaptable design can be used in sports venues to allow diverse training methods to be employed where coaches with varying training approaches would require different spatial conditions. The spaces should be flexible to be able to adapt to these changing physical needs.

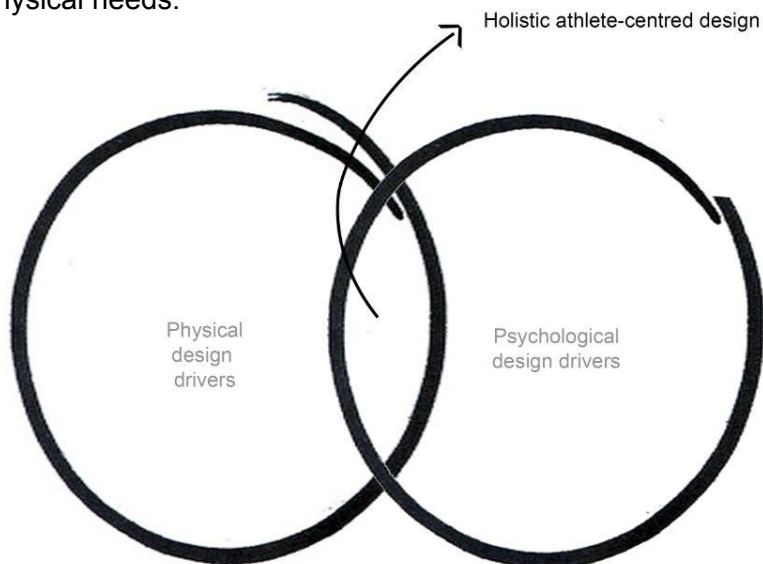


Figure 27: Holistic athlete-centred design (Adapted from Malkin, 2008).



## Conclusion

The setting for the majority of modern sports has well-defined 'boundaries' that regulate how the sport is played (Cleary, 2017). However, few building typologies or standards regulate optimum training or competition environments of intermediate spaces outside of the physical dimensions of the field of play. These intermediate spaces have major physical and psychological effects on the eventual performance of an athlete. An internationalised standard sports design prototype will not suffice. Rather, a holistic approach to athlete-centred design is needed that spatially responds to the athlete's psyche, emotions and physical condition in sustainable ways to promote the further development of the sporting industry and its athletes. In line with my normative position, a contextually responsive, sustainable and user-centred design that employs both functional and experiential design principles could potentially aid in spatially enhancing the athletic performance of local athletes in their training and competition environments.



Figure 28: Swimmers training at the TuksAquatics complex (Caldecott, 2019)