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The triple legacy of Olympic cities: a morphological assessment of Olympic stadia

Dr Laura Brown[1], Dr Alice Vialard[2]

[1] Department of Architecture & Built Environment, Faculty of Engineering & Environment, Northumbria University Newcastle, United Kingdom

[2] Department of Architecture & Built Environment, Faculty of Engineering & Environment, Northumbria University Newcastle, United Kingdom

Abstract

The Summer Olympic Games have the ability to significantly change the urban fabric through modification of the existing or the redevelopment of sites, depending on the choice of site procurement (Gold & Gold, 2008). Over the course of the twentieth century, models and visions for Olympic urban development shifted as the possibility for events to create infrastructural change in host cities and regenerate urban areas was realised. Whilst this had potential benefits for host cities, it also brought challenges for reuse, raising concerns around the sustainability of mega events. To deliver a more sustainable Games (International Olympic Committee (IOC), 2018), the current trend is to reuse existing buildings constructed for previous Olympics or other mega events. To assess the impact of the Games on the urban fabric, this study performs a historic survey of Olympic sites in three cities that have thrice been awarded the Summer Olympic Games (Paris 1900, 1924, 2024, London 1908, 1948, 2012, and Los Angeles 1932, 1984, 2028) through different periods of Olympic urban development. To appraise morphological changes to the urban fabric surrounding stadia: changes in density and size of building footprints are analysed in the 3 periods: before, during and after the construction of venues. Through the comparison of Olympic stadia, this paper examines the impact of implementing large individual buildings on the urban fabric. The implications of this study can help in making more informed choices in site procurement (city centre, urban fringe, or brownfield), scale of urban interventions and the benefit of reusing or upgrading existing venues in large scale events for a more resilient city.

Keyword: *Olympic Games, legacy, sustainability, stadium, site procurement*

Introduction

Ambulant sport and cultural mega-events such as the Olympic Games and World Fairs emerged over the course of the twentieth century as having the ability to deliver a range of benefits for the host city or region. As mega-events increased in scale, scope and popularity, new challenges began to arise for host cities and regions around the legacy and long-term function of venues. Created or repurposed for the event, they often entail significant costs. Mega events bear the potential to facilitate and advance urban development plans (Smith, 2012). However, with the growing scale and scope of the Games, alongside the desire to promote the host city through the creation of increasingly iconic and expensive architectures, questions have emerged around the sustainability of these events (Horne, 2007).

Typically, hosting a mega event is a once in a lifetime opportunity for a host city, but in recent years, awards of the Olympic Games have been allocated to previous hosts. The next three allocated Summer Olympic Games, in 2021, 2024 and 2028, are to be hosted by cities that previously hosted the Games: Tokyo in 1960,

Paris in 1900 and 1924, and Los Angeles in 1932 and 1984. Since the inception of the Games in 1896, only three cities have been allocated the event on three occasions, Paris, Los Angeles and London, who hosted the Games in 1908, 1948 and 2012. This offers the opportunity to look at and compare the different approaches adopted by these three cities.

This paper explores the models of Olympic urban development in those cities by appraising the impact of constructing their main and more iconic venue, the stadium, on their surrounding urban fabric. The site and the building are two entities that do not necessarily follow the same fate in terms of sustainability and legacy, although both hold equal significance. The first part introduces the different models for site procurement and the legacy of stadium. It is followed by a morphological analysis of the urban fabric, looking at the site pre-construction of the stadium and its evolution over the years.

While many stadia are used during a single edition of the Games, the stadium hosting the open or closing ceremony is the focus of this study as principal venue of the event. A total of seven stadia include: for Paris, Velodrome de Vincennes, also known as Cipale [CIP] in 1900, Stade Yves du Manoir [SYDM] in 1924 and Stade de France [SDF] in 2024; for Los Angeles, the Los Angeles Memorial Coliseum [LAMC] in 1932, 1984 and 2028; and for London, White City Stadium [WCS] in 1908, Empire Stadium [WES] in 1948 and London Olympic Stadium [LOS] in 2012.

The significance of the study is to highlight the different models of Olympic urban development that have been implemented in cities that have been awarded the Games on three occasions, and the impact of those interventions on the city. The implications of this study lie in its contribution to the literature on mega events and urban development: to support more informed choices in future host cities in relation to the procurement of sites (city centre, urban fringe, or brownfield), scale of development, and the choice to reuse or upgrade existing stadia or create new venues; and create more resilient cities.

Site procurement

The preferred solution of finding sites to locate the venues of the Olympic Games has long been to select sites with sufficient land for the assembly of venues close enough to the heart of the city to fit into the mainstream of urban life after the event, to promote reuse (Gold & Gold, 2018). Whilst central city locations are possible in the early stages of Olympic urban development, alternative models have been sought in recent decades as the demands of the event have increased.

In early editions of the Games, relatively small infrastructural requirements made it possible to use existing infrastructure or develop single venues on small pockets of land. Venues could be dispersed within the core of the city or located within a single cluster or a small number of concentrated nodes of activity. Finding undeveloped parcels of land for the required size and scale to accommodate venues within city centres became later increasingly difficult. As a result, the potential of the Games to facilitate and advance urban

development plans began to be harnessed: cities began to consider parcels of land on their periphery (Liao & Pitts, 2009).

The challenge of obtaining, developing, and converting Olympic sites has subsequently been managed using a diverse range of approaches, conceptualised as follows: *Temporary spatial hubs* (Roche, 2002), that subsequently require conversion for post-use; *Procured land in the city centre* for permanent retention, requiring large scale demolition of the existing urban fabric, and making use of prominent locations to underline the significance of events as important national projects; available parcels of *land on the Urban Fringe*, where ease of construction and lack of restrictive ordinances make up for distance from the urban core; the *reclamation of space* through dredging and infill; and, *brownfield conversion*, using land previously shunned from development due to heavy industrial pollution, where the prospect of large-scale Olympic investment essentially changes the cost consideration (Gold & Gold, 2018).

Stadium's legacy

A stadium, more than any other building typology has the ability to shape a town or city, put a community on the map, establish an identity, and provide a focal point in the landscape (IOC culture and heritage department 2016). In early editions of the Games, the main stadium is often a multifunctional venue, hosting a range of sporting events and the opening and closing ceremonies. However, managing the programme and requirements of different sports within a single architectural solution has become increasingly difficult as the scale and scope of events have expanded. In recent decades, the main function of the Olympic stadium has been to host athletic events and the opening and closing ceremonies. The stadium has become the focal point and centrepiece of the Games, inspiring increasingly iconic architectures that pose challenges for long term use due to their capacity, status and function (Kiuri & Teller, 2012).

One approach to more sustainable Games has been the construction of *temporary structure* (International Olympic Committee (IOC), 2014), although temporary stadia are still costly to construct, thus, there are questions around the long-term benefits to the host community. A second approach has been the use of *existing infrastructure* (Balderstone, 2001). However, this poses its own challenges as few existing stadia have the capacity or capability to host a mega event. Reusing existing stadia might require a third approach which is *large scale upgrade.* They are often necessary as the health and safety regulations for hosting large scale events and the infrastructural requirements of the governing bodies of elite and competitive sport continuously evolve. Furthermore, this model excludes all but developed cities with existing large-scale stadia from bidding to host large scale and mega events (Short, 2008).

Paris

For the second Summer Olympic Games in 1900, the city constructs the Cipale to host parts of the Olympic competitions in the urban park of Vincennes, edging the southeast boundary of Paris. Not a proper stadium,

the velodrome de Vincennes is a relatively small and light structure, built as one of the temporary buildings of the 1900 Universal Exhibition hosted partly in the park.

When Paris hosts the Games for the second time in 1924, the existing Stade Yves-du-Manoir is selected as the principal stadium of the Games. Constructed in 1907 on the site of an existing racetrack, it is located on the urban fringe of Colombes. The venue is upgraded for the 1938 World Cup, and several times after that, and will be upgraded again to host the 2024 field Hockey event.

With the city's successful candidature to host the 2024 Olympic Games, the choice has been to utilise an existing stadium as the principal venue for the Games. The Stade de France constructed for the 1998 football world cup on a brownfield near St Denis is located on the former site of a gas plant, which had been derelict since the 1970s (Paris: Candidate City for the Olympic Games 2024, 2016).

London

The city of London hosts the Summer Olympic Games for the first time in 1908 alongside the British-Franco exhibition. The principal venue, White city stadium is built on the urban fringe to host the events of the Games while being surrounded by the temporary buildings of the exhibition. The venue is upgraded in 1926 as a greyhound stadium and raceway track. The stadium is demolished in 1985, after 77 years of existence.

The 1948 Games are characterised by post-War austerity, which explains partly the use of an existing site. The principal site to host the events is the former site of the British Empire Exhibition of 1924-25 in Wembley. Located on the urban fringe, this site already accommodates much of the necessary required infrastructure, including the Empire Stadium, which is used as the main Olympic Stadium. Built in 1923 and upgraded in 1963, the empire stadium is demolished in 2002. It is replaced by a larger venue, the new Wembley stadium, in 2007.

When London is allocated the Games for the third time in 2012, a new stadium is constructed as the principal venue for the Games, London Olympic Stadium. It is located on a former industrial, brownfield site in Stratford, East London and is part of a masterplan to redevelop the full site (The London Organising Committee of the Olympic Games and Paralympic Games Ltd, 2013).

Los Angeles

The city of Los Angeles also uses an *existing* venue as its main stadium when it is first awarded the Summer Olympic Games in 1932: the Memorial Coliseum, constructed in 1921, close to the centre of Los Angeles in an existing residential area. It is built on an existing urban park, Exposition Park, that occupies an entire superblock of the urban grid extension of 1857. In contrast to the other editions of the Games, Los Angeles retains the same stadium when it hosts the Olympic Games for the second time in 1984. Los Angeles has been elected to host the Games in 2028, and has proposed to, again, utilise the Coliseum as its principal venue (Los Angeles: Candidate City for the Olympic Games 2024, 2016).

Table 1. Summary of the different approaches to site procurement an stadium's legacy by stadium.

	Site procurement						Stadium's legacy					
Stadium	Temporary	City Centre	Urban Fringe	Brownfield	Reclaimed Land	Urban Park	Existing	Upgrading	Demolished	Replaced	Still in use	*Age*
CIP	x					x					x	*121*
SYDM			x				x	x			x	*114*
WCS	x		x					x	x			*77*
LAMC		x				x	x	x			x	*100*
WES	x		x				x		x	x		*79*
SDF			x	x			x	x			x	*26*
LOS			x	x				x			x	*9*

The three cities show clear different approaches regarding stadium's legacy but overlap regarding site procurement (Table 1). The majority of stadium are built on the urban fringe except for two stadia built on existing urban parks. The stadium as a building shows more divided legacy that are more dependant to the decision of the hosting city. In Paris, the three stadia used for the three Summer Olympics are still in use, although two of them have been built at the turn of the 20th century and are more than 100 years old. By contrast, from the three different stadia used in London, the two older ones have been demolished after almost 80 years of existence and only the most recent Olympic stadium remains in use. Los Angeles is regarded as an exception with the use of single stadium for its three Olympic. With its century of existence, it demonstrates the possibility through upgrades to retain continuity of use for stadium typology.

Methodology

To appraise the impact of these stadia on the urban fabric, this study compares the urban fabric within a radius of half a mile (approx. 800m) in three periods: before the construction of the stadium, once it is built and the current, or future, state (figure 1). A total of 21 maps representing the seven areas at three different periods constitutes the final set.

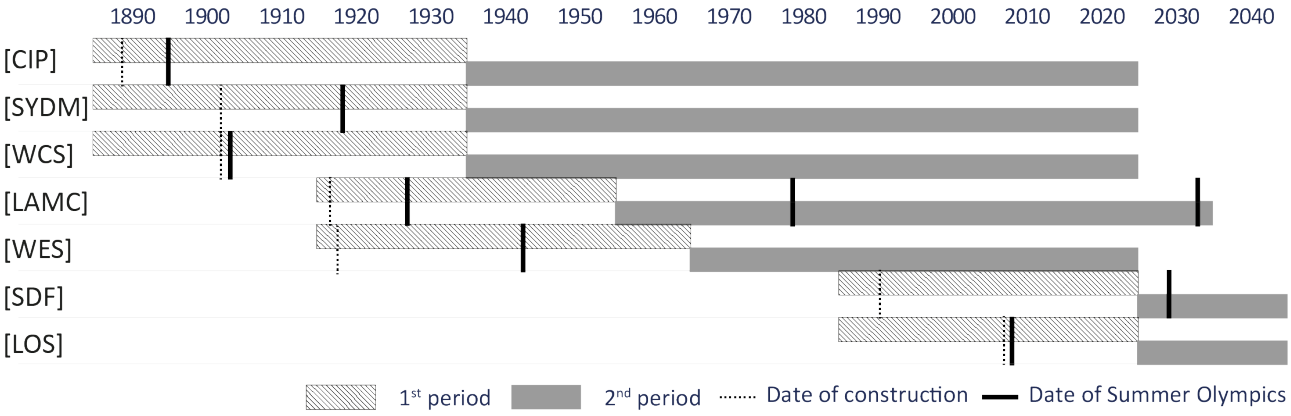

Figure 1. *Timeline showing the different periods studied for each stadium. The date of construction and the date of the Summer Olympics are provided as references.*

The methodology entails the appraising of morphological changes between the three periods. Morphological changes include the increase or decrease of the total area of built land (ground coverage), the size of the aggregated building footprints and the number of footprints. The number and the average size of aggregated building footprints provide information of the process of urbanisation. More footprints show an increase of the number of constructions, while less buildings combined with larger footprints highlight the densification process of infill by creating a continuous fabric as repletion occurs. Finally, less buildings and smaller footprints tend to indicate their removal.

Results and Discussions

The results are presented by city rather than by individual stadium to highlight the overall sustainability approach of each city and how it has developed over the years.

Morphological changes: Built density

From a density perspective (Table 2), the construction of a stadium has been associated with an increase of the built area (+340%) with, in general, an increase of number (+135%) and size (+90%). The general trend is a large increase of built area in the first phase (+236%), which is a combination of more construction (+123%) and larger building footprints (+50%). The second phase usually is more a phase of *consolidation* (+31%) with larger (+33%) and slightly more footprints (+6%). However, when looking at individual trends and when they occur, different urban strategies emerge.

Table 2. The values represent the percentage increases between the three periods: the first, second and total increases. Total built area [TBA], Number of aggregated footprints [N] & the mean size of aggregated building footprints [MBA] are also provided.

City	Stadium	Date	Period (years)	TBA - 1st Inc.	N - 1st Inc.	MBA - 1st Inc.	TBA -2nd Inc.	N - 2nd Inc.	MBA -2nd Inc.	TBA - Total Inc.	N - Total Inc.	MBA - Total Inc.	TBA (ha)	N	MBA (m^2)
Paris	CIP	1894	126	80	-27	145	7	4	3	92	-24	153	33.1	470	704
	SYDM	1907	113	200	249	-14	110	-1	112	529	244	83	39.1	1026	381
	SDF	1995	29	72	22	41	7	1	6	85	23	50	51.7	484	1069
London	WCS	1907	113	121	43	55	30	66	-22	187	136	21	54.5	633	861
	WES	1922	98	1127	568	84	21	4	16	1380	593	114	56.5	748	755
	LOS	2008	12	-25	-9	-17	29	15	12	-2	5	-7	41.0	361	557
L.A.	LAMC	1921	107	81	16	55	16	-44	106	109	-35	220	53.5	1548	346
Mean increase				236	123	50	31	6	33	340	135	90	47	361	668

Paris

While in all the cases, the construction of the stadium had a positive impact on the urbanisation, they represent three different approaches to the site procurement which has an impact on the type of urbanism that follows (Figure 2).

At the time of its construction, the site of the Cipale, located in an urban park**,** has an already clearly established urban edge on the south. The first phase shows a clear densification (+80%) with less constructions (-27%) but larger ones (+145%) characterising the *building infills* to create a continuous fabric. While the urbanised area sees a clear densification, the area north of the stadium remains fairly unchanged, excepted when temporary exhibitions are held. By 2020, the built area only grows so slightly as industrial buildings are replaced by administrative ones.

The Stade Yves-du-Manoir is built on a vacant site on the urban fringe. After its construction, the built surface within its surroundings triples between 1890 and 1934 with mainly new construction (+250%) in a more *disaggregated configuration* of smaller footprints (-14%) compared to the dense village core. Between 1934 and 2020, the area continues its urbanisation on a strong ascending slope (+110%) but this time the number of building slightly decreases (-1%) as the overall building footprints increase in size (+112%), showing some *densification by infill* and the presence of factories and housing estates.

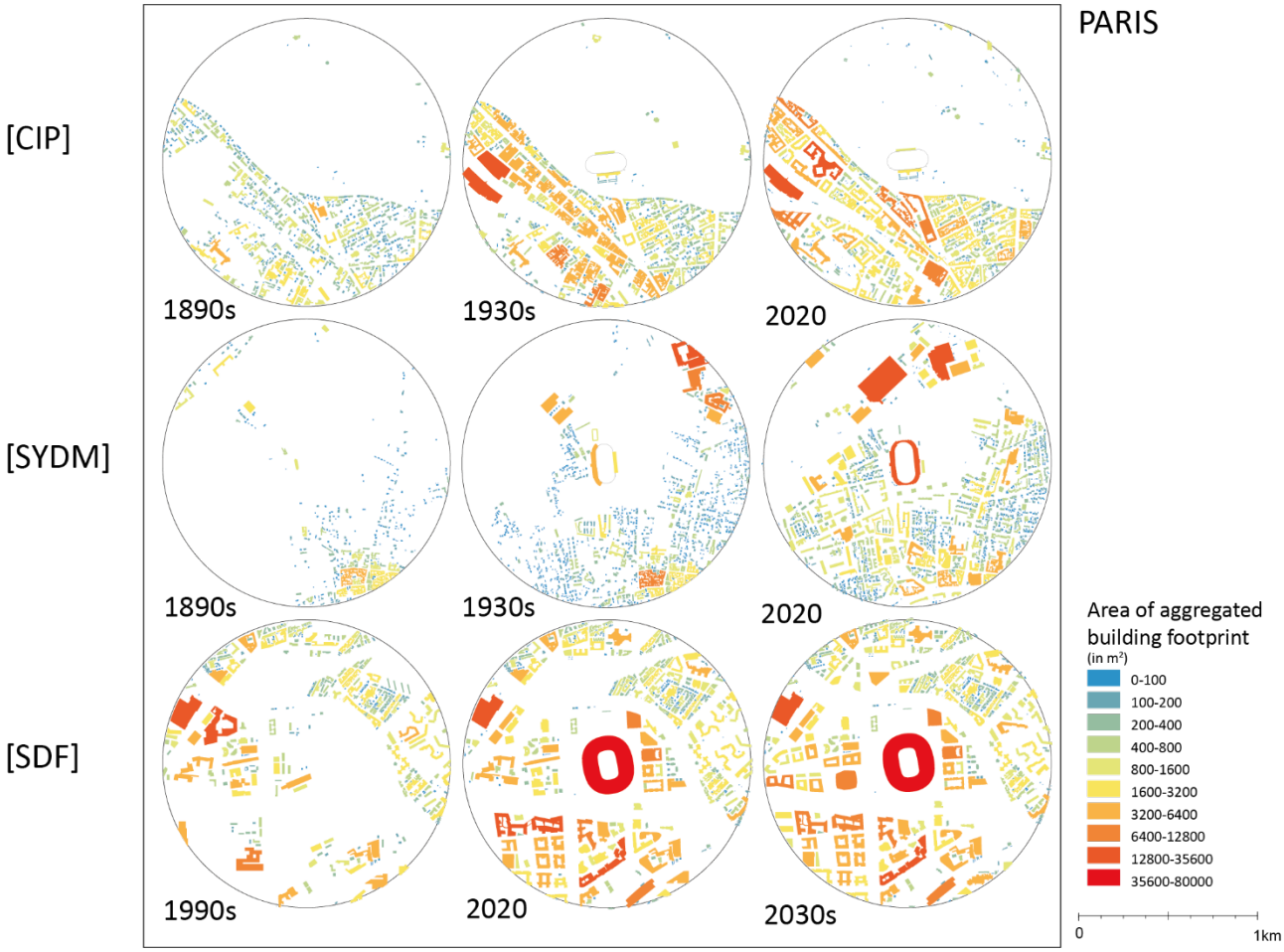

Figure 2. Paris - *Evolution of the building density over three periods for each stadium showing the size of aggregated building footprints.*

The Stade de France is built in 1998 on a *brownfield* with only few buildings remaining. By 2010, the density of construction has grown by 72% with more (+22%) and larger buildings (+41%) showing a rapid *redevelopment* of the area. With the prospect of hosting the next summer Olympics, the city of St Denis projects the construction of additional venues on the site as well as the *upgrading* of housing estates from the 1960s which leads to a slight densification (+7.4%).

London

Two of the early stadia follow a very similar trend in their emergence, they have however slightly different impact on the urban fabric (Figure 3).

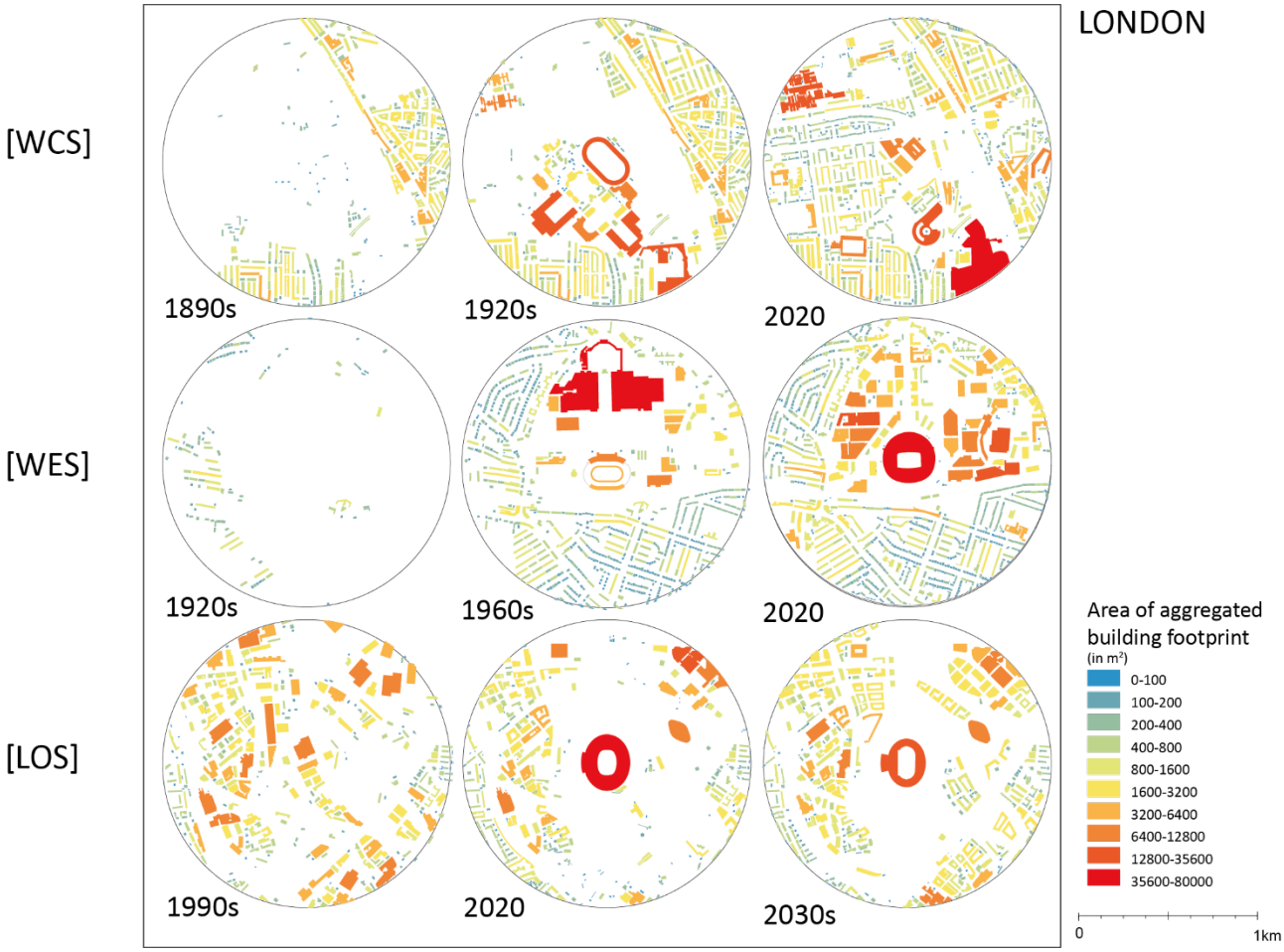

Figure 3. London - *Evolution of the building density over 3 periods for each stadium showing the size of aggregated building footprints.*

Built on rural-urban fringe sites, they are both part of a larger temporary exhibition at the time of their construction: the 1908 Franco-British Exhibition and the British Empire Exhibition of 1924-1925. As such, the building density increases with a combination of more and larger buildings. This is also the period where the average size of the buildings is the largest (1,100m^2) due to the large buildings of the exhibitions. In the following decades, the exhibition buildings are slowly replaced. With a similar increase of density, the second period of growth however differs for the two stadia, which are both eventually demolished. In White City, there is a decrease of size footprints (-22%) and an increase of their number (+66%) showing a densification by *replacements* of large buildings by smaller ones. In Wembley, after the demolition of the stadium, the *redevelopment* of the area begins. The number of new constructions keeps on increasing on a much slower trend (+4%) but the existing buildings are *replaced* by mainly larger buildings (+16%), including the new Wembley stadium. The redevelopment of the area is still currently being implemented.

The trend for the last summer Olympic in London differs from the rest of the stadia, including from Paris and Los Angeles. The Olympic stadium is located on a brownfield site with a high building density. The industrial fabric is made of many large buildings (1,200m^2) and is the only site in ours sample which was not vacant at

the date of the construction of the stadium. Therefore, the first period of development shows a decrease of building density (-25%). Less buildings (-9%) and smaller ones (-17%) resulting from the *clearance* of large existing industrial buildings. However, the masterplan proposed tends to indicate an increase of density for the future (+30%) with *new developments* similar to Wembley: more (+15%) and larger buildings (+12%). This will bring the built density to similar level before the clearance, with only the land use changed from industrial to mixed-use.

Los Angeles

The approach of Los Angeles is quite unique as it is the only city that retains the same stadium for all three Olympics (Figure 4).

[LAMC]

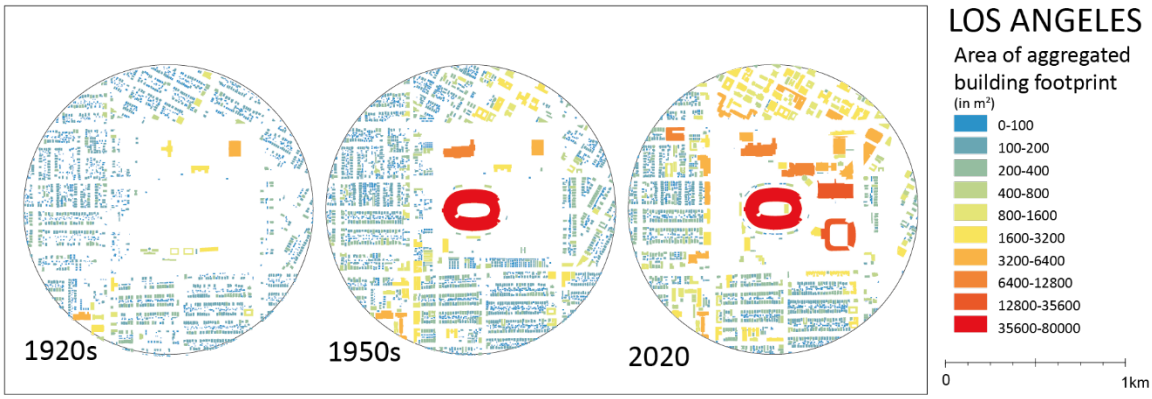

Figure 4. Los Angeles - *Evolution of the building density over 3 periods showing the size of aggregated building footprints.*

In 1922, the surrounding residential blocks are already partially developed with mainly single detached houses. The building density increases by 80% between the two first Olympics by *addition* of new constructions (+16%) and larger ones (+55%). The main transformations of the urban fabric occur between the 1950s and 2020s with a smaller increase in terms of total footprint area (+16%) but a drastic transformation of the building type: less buildings (-44%) but much larger (+106%). Single-family houses are *replaced* by large institutional buildings such as on the nearby USC campus as well as more sport facilities and museums within Exposition park. This trend tends to be continuing for 2024 with the building of a new museum and the recent Banc of California Stadium in 2018.

Stadium size

The size of the stadium has evolved over time, growing also on height, and becoming more visually prominent as the building shifts from Grandstand to all-around seating with multiple tiers. The mostly open-air light structures at the turn of the 20th century have evolved into massive structures by the turn of 21st century. The size of the seating area footprints ranges from 4,000 to 60,000 m^2 (Figure 5).

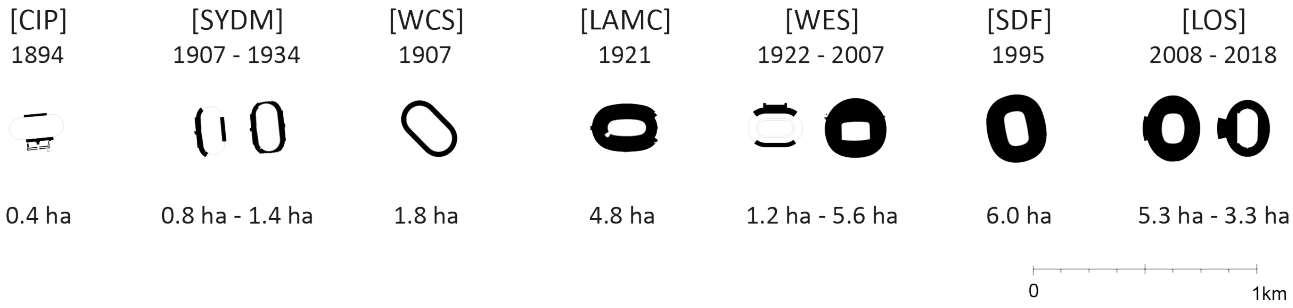

Figure 5. *Comparison of footprint of the stadia with their date of construction and footprint area.*

There is a clear correlation between the date of construction and the size of the construction (R^2=0.59, n=10, p=0.0094*) showing a consistent increase in building footprint. This change in sizes impacts greatly how the transition between the stadium and its surroundings develop, and the need to create a buffer zone.

Conclusions

In the early Summer Olympic Games, stadia have been used as catalyst for urbanisation on the rural and urban fringes and were often part of temporary exhibitions. These mega events brought attention to their surroundings which have developed almost simultaneously. Temporary in nature, most buildings of the exhibitions are quickly replaced by new typologies although the stadium remains the longest in place and in use.

In more recent games, the main changes occurred with the size of stadia which have become increasingly bigger. This change in size requires the presence of a buffer. The buffer can be a large gap between the stadium and its surroundings. But as an alternative, buildings within the vicinity of the stadium can have larger footprint to act as a buffer. The best example is in Los Angeles where the partially urbanised area around the park goes through a phase of densification as well as replacement of single-family houses into larger buildings. A similar strategy is implemented around the new Wembley stadium, which allows for a similar setback between the stadium and the surrounding buildings.

Finally, the latest trend with London, the use of a brownfield site already occupied by derelict buildings, shows an approach to site procurement that for once does not increase the built density, and a reduction of the stadium footprint to better fit the needs after the Games.

The study of urban morphology in the immediate context of the stadium allows us to understand the impact of large-scale stadia on the urban environment in the long term, and the integration of mega event stadia into the immediate environment and local community. As events stadia become larger and more iconic, the tension between event use and community uses increasingly pose greater challenges. Given the evolving requirements of sporting federations and updates to health and safety regulations, events stadia generally

require updating over the course of their lifespan in order to be able to continue hosting mega events. The appropriate development in the immediate vicinity of the site supports the long-term use of the site and of the building.

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