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Assessing Olympic Venue Legacy and Long-Term
Sustainability: A Life-Cycle AHP Framework for
Unipol Dome

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Abstract

Olympic venues are long-lived infrastructures generated by short-term events. Their legacy cannot be assessed only through delivery, architectural quality or event-time performance, but depends on their capacity to sustain use, management and urban relevance after the Games. This thesis examines this issue through the case of Unipol Dome, the multifunctional arena developed for the Milan-Cortina 2026 Winter Olympic and Paralympic Games within the Milano Santa Giulia regeneration area.

The research adopts a qualitative-comparative approach supported by a life-cycle evaluation framework based on the Analytic Hierarchy Process. Literature on Olympic legacy, sustainability and white elephant risk is combined with case-study evidence and benchmark analysis of Richmond Olympic Oval and London Aquatics Centre. These references are used to identify the conditions that support stronger post-event trajectories.

The main contribution of the thesis is the development of an ex-ante assessment framework structured around three phases: design and planning, construction, and in-use operation. Weighted criteria, performance scoring and sensitivity analysis are used to evaluate the long-term sustainability potential of Unipol Dome.

The findings suggest that Unipol Dome starts from a comparatively strong position, especially in relation to its design logic, multifunctional configuration and strategic location within the Santa Giulia regeneration area. However, the long-term outcome remains open. The most sensitive variables are concentrated in the post-event phase, where the venue will have to demonstrate regular activation, diversified programming, operational balance, governance continuity and effective integration with the surrounding district. The thesis therefore argues that the arena's legacy will depend less on its Olympic role than on the capacity to transform that temporary visibility into a stable and adaptive operating model.

Key-words: Olympic Legacy; Venue Sustainability; AHP Framework.

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Abstract in italiano

Le venue olimpiche sono infrastrutture di lunga durata generate da eventi a breve termine. La loro eredità non può essere valutata solo attraverso la consegna, la qualità architettonica o la performance in tempo di evento, ma dipende dalla loro capacità di sostenere l'uso, la gestione e la rilevanza urbana dopo i Giochi. Questa tesi esamina questa questione attraverso il caso dell'Unipol Dome, l'arena multifunzionale sviluppata per i Giochi Olimpici e Paralimpici Invernali Milano-Cortina 2026 all'interno dell'area di rigenerazione Milano Santa Giulia.

La ricerca adotta un approccio qualitativo-comparativo supportato da un quadro di valutazione del ciclo di vita basato sul Processo di Gerarchia Analitica. La letteratura su eredità olimpica, sostenibilità e rischio di elefante bianco è combinata con evidenze di casi e analisi di riferimento del Richmond Olympic Oval e del London Aquatics Centre. Questi riferimenti vengono utilizzati per identificare le condizioni che supportano traiettorie post-evento più forti.

Il contributo principale della tesi è lo sviluppo di un quadro di valutazione ex-ante strutturato attorno a tre fasi: progettazione e pianificazione, costruzione e gestione in uso. Criteri ponderati, valutazione delle prestazioni e analisi di sensibilità vengono utilizzati per valutare il potenziale di sostenibilità a lungo termine di Unipol Dome.

I risultati suggeriscono che Unipol Dome parte da una posizione relativamente forte, soprattutto in relazione alla sua logica progettuale, configurazione multifunzionale e posizione strategica all'interno dell'area di rigenerazione di Santa Giulia. Tuttavia, l'esito a lungo termine rimane aperto. Le variabili più sensibili sono concentrate nella fase post-evento, dove la sede dovrà dimostrare attivazione regolare, programmazione diversificata, equilibrio operativo, continuità della governance e un'integrazione efficace con il distretto circostante. La tesi sostiene quindi che l'eredità dell'arena dipenderà meno dal suo ruolo olimpico che dalla capacità di trasformare quella visibilità temporanea in un modello operativo stabile e adattivo.

Parole chiave: Eredità olimpica; Sostenibilità delle sedi; Quadro di riferimento AHP.

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Introduction

Olympic venues are built for an event that lasts only a few weeks, yet they remain in the city for decades. This imbalance is simple to state and much harder to resolve. The short temporal cycle of the Games and the long temporal cycle of infrastructure rarely coincide without friction. What appears efficient during the event can later become excessive, underused or economically burdensome. For this reason, the long-term value of Olympic venues cannot be judged only through delivery, architectural quality or event-time performance. It depends on what happens afterwards. More precisely, it depends on whether the venue is able to sustain use, management and urban relevance once the exceptional conditions of the Games have disappeared.

This thesis develops from that premise. Its focus is Unipol Dome, the multifunctional arena built within the Milano Santa Giulia regeneration area and linked to the Milano-Cortina 2026 Winter Olympic and Paralympic Games. The arena offers an especially revealing case. It is not a minor support facility, nor a highly specialised venue destined to face immediate conversion problems. It is a large metropolitan arena conceived from the outset as a structure that should continue to operate through concerts, sport and live entertainment after the Olympic phase. That apparently favourable condition makes the case more interesting, not less. A multifunctional venue may begin from a stronger position than many past Olympic facilities, yet it remains exposed to a more subtle risk: not abandonment in the strict sense, but partial under-consolidation. A venue of this scale does not fail only when it closes. It can also fail when use remains too irregular, when operating burden becomes disproportionate, or when the promised relationship with the surrounding district never fully stabilises.

The research is situated within a broader critical debate on Olympic legacy, sustainability and white-elephant risk. Over time, Olympic studies have moved away from a celebratory reading of mega-events and have become more attentive to their long-term consequences. Legacy is no longer treated as an automatic by-product of hosting. It is increasingly understood as a planned, negotiated and measurable process. In the same way, sustainability cannot be reduced to environmental rhetoric or technical certification. For a venue, it involves a wider set of conditions: economic viability, continuity of use, governance capacity, urban integration and the ability to remain meaningful beyond the event that justified its construction. These issues are particularly relevant for arenas, which occupy an intermediate position in Olympic infrastructure. They are usually more flexible than highly specialised winter facilities,

but they are still vulnerable to oversizing, high operating costs and post-event uncertainty.

Within this framework, the thesis asks a specific question: how can the long-term sustainability of Unipol Dome be interpreted before a full post-event history is available, and which conditions are most likely to influence its future trajectory? The objective is not to produce a deterministic forecast. It is to construct a reasoned evaluative framework capable of identifying the main variables that may support or weaken the arena's long-term performance. This means moving beyond description. The thesis does not limit itself to reconstructing the project, nor to summarising the broader context of Milano-Cortina 2026. It seeks to assess the arena as a long-lived infrastructure whose future depends on the alignment between design choices, construction conditions and in-use operation.

Methodologically, the research adopts a qualitative-comparative approach supported by a life-cycle evaluation framework. The work begins with a theoretical discussion of Olympic mega-events, sustainability, legacy and white-elephant risk. It then situates Unipol Dome within the institutional and territorial structure of Milano-Cortina 2026, before examining the arena itself through its genesis, ownership structure, investment logic, technical features and urban role inside the Santa Giulia regeneration process. The analysis does not stop at the case study. Two post-Olympic benchmark venues—Richmond Olympic Oval and London Aquatics Centre—are introduced in order to identify recurrent factors associated with stronger long-term outcomes. These cases do not function as ideal models to be copied mechanically. Their value lies in showing, through real post-event trajectories, how design anticipation, governance continuity, adaptive transformation and diversified use can support a more durable legacy.

On this basis, the thesis develops an AHP-based life-cycle evaluation framework structured around three phases: design and planning, construction, and in-use operation. The model does not treat legacy as a vague promise. It translates the problem into criteria, sub-criteria and indicators, then applies a weighting structure, performance scoring and sensitivity analysis in order to assess the long-term sustainability potential of Unipol Dome. The purpose of this framework is not to replace critical interpretation with a purely numerical result. Its function is narrower and more useful. It provides an explicit structure through which the main strengths, weaknesses and areas of uncertainty of the arena can be made visible. In particular, it allows the research to distinguish between those favourable conditions that are already embedded in the project and those that still depend on future operation.

The results support a measured interpretation. Unipol Dome appears to begin from a comparatively strong position, especially in relation to its multifunctional configuration, technical ambition and metropolitan location within a wider regeneration area. Yet the long-term outcome remains open. The most sensitive

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variables are concentrated in the post-event phase, where the venue will have to demonstrate regular activation, diversified programming, operational balance, governance continuity and effective integration with the surrounding district. This is the real threshold of the research. The arena's legacy will depend less on its temporary Olympic visibility than on the capacity to convert that visibility into a stable and adaptive operating model.

1. Olympic Games, sustainability and venue legacy

1.1. The Olympic Games as mega-events

The Olympic Games occupy a singular position within the broader universe of international events. They are sporting competitions but reducing them to sport alone produces a distorted reading. Their relevance lies in the fact that they compress, within a limited temporal frame, a much wider process involving infrastructure delivery, urban transformation, political negotiation, institutional coordination, financial mobilisation and symbolic projection at a global scale. As observed by Frawley and Adair (2013) and Toohey (2008), the Games operate as a dense organisational system rather than as a simple sequence of competitions.

This density is what places the Olympics within the category of mega-events. The label does not depend only on audience size or media visibility, though both are obviously central. It depends on the extent to which the event reorganises the territory that hosts it. Public expenditure rises sharply, private capital is attracted or redirected, mobility systems are accelerated, sometimes redesigned, governance becomes multilayered. Local administrations, national governments, investors, developers, sports bodies and operators are pushed into an unusually intense field of interaction. Barclay (2009) notes that precisely this scale of mobilisation makes mega-events especially difficult to evaluate through ordinary cost-benefit logic.

The International Olympic Committee (IOC) frames and regulates this process through the Olympic Charter and through the assignment of the Games to host cities and territories. The Olympic cycle, alternating Summer and Winter editions every four years, requires not only sporting preparation but the establishment of a temporary yet highly complex institutional machinery, usually centred on an Organising Committee responsible for operational delivery. Toohey (2008) insists that the managerial dimension of the Olympics should not be treated as ancillary. It is part of the event's very nature.

There is, however, a more problematic reason why the Olympics matter so much in academic and professional debate. Mega-events are often defended as catalysts. They are said to accelerate projects that would otherwise remain suspended for years in administrative delay, financial uncertainty or political indecision. That claim is not baseless. The literature has shown that Olympic hosting can indeed function as an extraordinary lever for public works, international repositioning and urban redevelopment. Still, the same acceleration mechanism tends to generate rigid deadlines, compressed decision-making and an overexposure to urgency. What looks efficient in the short term may later prove fragile when judged against ordinary urban demand, operating costs and post-event adaptability, as Barclay (2009) and Toohey (2008) both suggest in different ways.

The most difficult issue emerges here. The event is temporary; the infrastructure is not. Olympic competitions last a matter of weeks. Venues, transport upgrades and urban transformations remain for decades. This asymmetry sits at the centre of contemporary Olympic studies. Chen (2015) and Preuss and Plambeck (2021) show that the quality of Olympic planning cannot be measured only by whether the event runs smoothly. The real test begins later, when infrastructures are asked to perform without the exceptional intensity, extraordinary visibility and institutional protection that exist during the Games.

For this reason, Olympic venues deserve special analytical attention. They are the point at which investment, management and urban permanence intersect. They condense the broader contradiction of the Olympic model: a short-lived event requiring long-lived structures whose value will depend less on the ceremony of opening than on the slow, uneven and often difficult transition to post-event life.

1.2. Evolution of the Olympic model

The Olympic model has not remained stable over time. During the early modern editions, the Games were generally interpreted as an international sporting celebration, rich in symbolic value but still relatively limited in their urban and infrastructural implications when compared with later decades. That image no longer holds. As Toohey (2008) and Scheu et al. (2021) make clear, the twentieth and twenty-first centuries transformed the Olympics into a far more ambitious political, economic and territorial enterprise.

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Post-war editions, especially from the 1960s onward, increasingly linked the Games to modernisation, technological display and the production of metropolitan image. Brown (2020) shows that Winter Olympics in particular became entangled with ideas of territorial development and strategic visibility, while Davis (2020) highlights the extent to which venue design itself came to embody political aspirations, architectural ambition and urban branding. The result was predictable. Olympic infrastructures became larger, more expensive and more exposed to long-term risk.

At the same time, enthusiasm for the event's transformative power began to clash with the empirical record. Cost overruns, overestimated benefits, oversized venues and weak post-event conversion generated a substantial body of criticism. Barclay (2009) is especially sharp on this point, noting how optimistic projections often obscure the enduring burden of infrastructure once the event has ended. That critical literature gradually shifted the evaluative focus. The question was no longer whether the Games had been staged successfully. It became whether anything of lasting value had actually followed from them.

This is the context in which the notion of legacy moved from a marginal concern to a central category of Olympic analysis. Chen (2015) treats legacy not as a rhetorical afterthought but as a field of long-term strategic planning. Scheu et al. (2021) similarly show that the success of the Games is now judged increasingly through their durable outcomes, both material and intangible. This change matters because it modifies the whole logic of Olympic infrastructure. A venue cannot be considered successful simply because it worked in February or August. It must also remain meaningful when the event has disappeared from the global stage.

Institutionally, this shift is visible in the reform language promoted by the IOC in recent years. The move toward reuse, adaptability, cost containment and more cautious infrastructure planning reflects a broader recognition that the monumental logic of earlier Olympic cycles had become difficult to defend. Essex and Sanchez (2024) read this as part of a wider effort to align Olympic hosting with more explicit sustainability narratives, while the reform agenda associated with the Olympic Agenda 2020 pushed further in the direction of flexibility and reduced new-build dependence.

For venue planning, the implications are direct. Capacity can no longer be treated as a self-evident virtue. Neither can iconicity. The same applies to technological sophistication if it is detached from long-term operating feasibility. Davis (2020) and Tang et al. (2024) both stress that post-event compatibility has become a decisive criterion. Modularity, scalability, operating efficiency, accessibility and flexibility of

use now carry far more analytical weight than they did in older, spectacle-driven models.

The question, then, is no longer whether a venue can satisfy Olympic demand at peak intensity. That is only the entry threshold. The harder question is whether the same structure can later operate within an ordinary market and urban context without sliding into underuse, overspecialisation or chronic managerial pressure. That is where the contemporary Olympic model now reveals its actual maturity or its weakness.

1.3. Sustainability of the Games and infrastructure

1.3.1. Sustainability as a multidimensional category

Within Olympic discourse, sustainability has become unavoidable. The term appears constantly in institutional documents, candidature narratives and post-event evaluations. Yet its very frequency has often emptied it of precision. If sustainability is reduced to environmental performance alone, the concept becomes too narrow to explain the real behaviour of Olympic venues. These infrastructures are not only energy-consuming objects. They are financial, social, territorial and managerial entities. Chen (2015) and Tang et al. (2024) both argue, implicitly and explicitly, for a broader analytical frame.

A more convincing interpretation treats sustainability as multidimensional. In this sense, it involves environmental efficiency, economic viability, social accessibility, urban compatibility and management capacity. Olympic infrastructures are shaped by all of these dimensions at once. One can design a low-carbon venue that later proves economically unsustainable. One can build a technologically sophisticated arena that remains socially weak because it fails to become part of everyday urban life. One can produce an architecturally refined object that performs poorly because governance and operation were never properly aligned with its post-event function.

This thesis adopts that wider reading. It is methodologically preferable because it avoids an error that recurs frequently in public narratives: the assumption that “green” design standards automatically imply long-term success. They do not. Sustainability has to be tested across the whole life of the venue, not only through isolated design attributes.

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1.3.1.1. Sustainability across the venue life cycle

A life-cycle perspective is necessary here. Olympic venues do not become sustainable or unsustainable at one single moment. Their long-term condition is progressively shaped through design, construction and use. Celani et al. (2023) and Tang et al. (2024) provide a useful basis for this approach by showing how built-environment quality and sustainability should be assessed across multiple phases rather than at the end of the delivery process alone.

In the design phase, the issue is anticipation. Capacity, flexibility, accessibility, technological systems, spatial adaptability and energy strategy all matter because they determine whether the venue is being conceived only for Olympic requirements or also for later, ordinary demand. Overspecialisation is often seeded here. A building can be technically impressive and still be wrong for its future.

During construction, the problem changes. Delivery pressure becomes dominant. Site management, logistics, procurement, risk control, waste handling, emissions and safety all enter the field. Sun et al. (2008) show how the compressed calendar typical of Olympic construction sites heightens exposure to risk and requires more integrated control systems than ordinary projects. Sustainability in this phase is less about aspiration and more about execution.

In the use phase, the abstract becomes measurable. Operating cost, maintenance demand, energy consumption, event frequency, utilisation intensity and urban integration all become observable indicators. Preuss and Plambeck (2021) make a decisive point here: legacy is not a symbolic attribute attached to a venue. It is revealed through long-term patterns of use. Once that is accepted, sustainability must be read as a longitudinal condition rather than a design statement.

This is why the life-cycle perspective is not merely a methodological preference. It is the only way to understand how Olympic venues generate either lasting value or persistent burden.



Figure 1.1 - Three-phase life-cycle framework for the assessment of Olympic venues. Source: author's elaboration.

1.3.2. Environmental sustainability

Environmental sustainability concerns the impacts generated by a venue over time: resource consumption, emissions, material choices, site externalities and operational demand. In Olympic infrastructures this dimension extends from initial conception to eventual conversion, where conversion occurs. Tang et al. (2024) and Essex and Sanchez (2024) both insist that environmental evaluation loses much of its meaning if it is isolated from the full trajectory of the venue.

In design terms, environmental sustainability depends largely on passive strategies, system efficiency, envelope performance, low-impact materials and energy planning. In construction, the emphasis shifts toward logistics, waste, safety, disturbance reduction and control of on-site processes. Sun et al. (2008), writing in the context of Olympic venue construction, show how complexity itself becomes an environmental management issue when timing is tight and coordination fragmented.

The operational phase is often the most unforgiving. Indoor arenas, in particular, are technically demanding buildings. Heating, cooling, ventilation, lighting and fluctuating event loads produce a structurally high energy profile. Tang et al. (2024) underline that this makes arenas especially sensitive to questions of actual operating efficiency rather than nominal design performance. Put simply: the building may have been designed well and still behave badly in use.

There is another difficulty. Environmental performance cannot be judged independently from use intensity. A venue built to high environmental standards but left underused for long periods does not automatically represent a sustainable outcome. Preuss and Plambeck (2021) suggest this indirectly through their emphasis on utilisation, while Tang et al. (2024) make the broader sustainability link clearer. A building whose embodied impacts are not matched by sufficient long-term use remains environmentally ambiguous, however advanced its technical profile may appear on paper.

1.3.3. Economic sustainability

Economic sustainability refers to the ability of the infrastructure to maintain a reasonable relation between investment, operation, maintenance and generated

revenue over time. It also concerns the extent to which the venue avoids becoming a recurring financial burden for public authorities or private operators. Frawley and Adair (2013) and Barclay (2009) both point to the tendency of mega-event planning to privilege initial delivery while underestimating long-run cost exposure.

For Olympic venues, economic sustainability operates on at least two levels. One concerns the initial cycle of design, construction and associated infrastructure investment. The other concerns the post-event cycle of operation, maintenance, staffing, services, safety, upgrades and managerial overhead. The first level is spectacular and politically visible. The second is slower, less visible and often more decisive.

A recurring problem is that venues are dimensioned according to Olympic peak demand rather than ordinary post-event absorption capacity. Preuss and Plambeck (2021) connect this directly to later utilisation pressures, while Tang et al. (2024) read it as one of the mechanisms through which white elephants emerge. An oversized venue with a weak calendar is not simply inefficient. It is structurally unbalanced.

For multifunctional arenas, economic sustainability depends on a cluster of interrelated variables: intensity of annual use, diversification of the event portfolio, operational efficiency, accessibility, quality of management and the ability to generate varied revenue streams. None of these works in isolation. A venue may have a solid event calendar but still struggle if its operating model is too heavy. It may have strong design attributes but remain economically fragile if market demand is thinner than expected. The issue is not whether the venue earns money in abstract terms. The issue is whether its long-term profile is absorbable.

1.3.4. Social sustainability

Social sustainability is often discussed in broad and rather vague terms, but in the context of Olympic infrastructure it has a more concrete meaning. It concerns whether the venue produces accessible and widely distributed benefits rather than operating as an enclave for narrow user groups. Chen (2015) and Essex and Sanchez (2024) both point toward this broader reading of social impact, though from different angles.

A venue can be financially active and symbolically prominent while remaining socially weak. That happens when its functions are too exclusive, its access too restricted, its event mix too narrow or its relation with the surrounding community too thin. Social sustainability, then, is not reducible to occasional public

use. It concerns the degree to which the venue becomes legible and useful within the everyday life of the city.

For indoor arenas, the question is especially delicate. These buildings often rely on commercial programming and high-profile events, which can easily produce a selective pattern of use. The issue is not to deny that commercial success matters. The problem arises when that success fails to generate a broader urban and social role. A socially sustainable arena should be more than a profitable event machine. It should become, at least to some extent, part of a shared urban system.

This is where programming matters. So do accessibility, transport integration, event diversity and the presence of complementary functions. Social sustainability is rarely produced by architecture alone. It emerges from repeated use patterns and from the venue's capacity to avoid social insulation.

1.3.5. Urban and territorial sustainability

Urban and territorial sustainability treats the venue as part of a wider spatial system. A venue that functions internally but remains detached from the city cannot easily generate a robust legacy. Brown (2020) and Chen (2015) both show, in different contexts, that Olympic infrastructure is deeply conditioned by the territorial logic into which it is inserted.

The Olympic promise of urban regeneration is familiar. Host cities often justify major venue investment through the expectation that the event will accelerate the redevelopment of marginal, underused or strategically sensitive areas. Sometimes that happens. Sometimes the venue remains a foreign body within the urban fabric. Essex and Sanchez (2024) argue that the difference often lies not in the rhetoric of regeneration but in the actual quality of integration: accessibility, public-space design, compatibility with surrounding uses and continuity with wider urban rhythms.

This dimension is especially relevant when the venue is embedded in a district-scale transformation, as in the case of Santa Giulia. Here the success of the venue cannot be separated from the trajectory of the broader urban project. A technically successful arena placed in a weak or incomplete territorial setting may still struggle to consolidate long-term value. Urban sustainability, then, is not an external bonus. It is part of the venue's operational condition.

1.3.6. Management sustainability

Management sustainability deserves to be isolated because it is too often hidden behind design discourse. Yet many post-event failures stem less from architectural inadequacy than from weak governance, unclear responsibilities, poor market reading or fragile operating structures. Preuss and Plambeck (2021) connect utilisation to long-term management performance, while Ciaramella and Celani (2023) emphasise the broader role of risk control and process structure in built-asset viability.

A sustainable management setting is one in which the venue can be monitored, maintained, programmed and adapted through coherent organisational processes. Governance model, concession structure, risk distribution, operator competence, maintenance planning and performance monitoring all matter here. Garavelli (2024) shows how the governance of mega-events already reveals the complexity of actor coordination during delivery; that complexity does not disappear after the Games. It changes form.

Without a credible management model, even a venue that is well designed and territorially integrated can deteriorate into inefficiency. This is why management should not be treated as a post-construction concern. It is embedded in the venue from the start, whether planners admit it or not.

1.4. Olympic venues and the risk of white elephants

1.4.1. Venues as critical infrastructures of the Olympic system

Within the Olympic system, venues are the point where expenditure, visibility and long-term risk converge most sharply. They are not the only relevant infrastructures, but they are often the most exposed. Davis (2020) and Toohey (2008) both note that venues tend to become the most visible material legacy of the Games, which is precisely why their later failure attracts such intense scrutiny.

Olympic venues vary considerably in typology. Stadiums, indoor arenas, aquatic centres, ice rinks, media facilities and Olympic villages do not present the same post-event challenges. Some are highly specialised. Others, at least in theory, are more flexible. Preuss and Plambeck (2021) and Tang et al. (2024) both suggest that

multifunctional venues start from a stronger position, but even here the advantage is conditional rather than automatic.

A recurring planning mistake has been to design venues with overwhelming attention to Olympic performance while treating post-event life as a secondary issue. That imbalance is costly. A venue that succeeds only within the extraordinary circumstances of the Games may later reveal itself to be spatially rigid, economically burdensome or territorially isolated. Once that happens, symbolic success does little to protect it.

1.4.2. Definition and mechanisms of formation of the white elephant

The term white elephant is commonly used to describe an expensive asset that is underused, difficult to maintain and unable to justify its permanence through proportional benefit. In the Olympic field, the concept refers above all to venues that fail to secure a coherent post-event function or remain burdened by operating costs far beyond what their actual use can sustain. Tang et al. (2024) and Davis (2020) both frame the issue in these terms.

The white elephant is not reducible to abandonment. That is too narrow. A venue may remain open and still function as a white elephant if utilisation is low, revenues are weak and management burden remains excessive. Preuss and Plambeck (2021) help make this point clearer by tying legacy evaluation to actual performance over time rather than to mere physical survival.

Several recurrent mechanisms contribute to the formation of white elephants. Oversizing is one. A venue built for temporary Olympic demand may become too large for its later market. Weak legacy planning is another. If post-event use is addressed late, conversion tends to become improvised and ineffective. Governance also matters. Without a competent operator, realistic programming and an economically credible management structure, even a potentially flexible venue may drift toward chronic underperformance. Urban integration is equally decisive. A detached venue, poorly connected and unsupported by surrounding functions, struggles to stabilise use. Then there is overspecialisation. The more technically narrow the building, the harder it becomes to adapt.

These mechanisms rarely act alone. White elephants are usually produced by accumulation rather than by one single planning error.

1.4.3. Examples of failure

Post-event failure is not randomly distributed across Olympic infrastructure. Scheu et al. (2021) and Tang et al. (2024) show that some venue types are much more exposed than others: highly specialised buildings, oversized facilities and structures lacking a stable tenant or a realistic post-event function. The problem is not simply that the Games end. It is that the venue enters ordinary life without a viable operating logic.

Athens 2004 remains one of the clearest examples. Kasimati (2015) documents the extent to which several Olympic venues failed to secure a coherent afterlife, with some facilities left in prolonged uncertainty and others never truly integrated into a durable urban or economic function. The issue was not merely technical decline. It was strategic absence. Legacy planning arrived late, if at all.

The Athenian case is especially revealing in relation to venues associated with sports that had weak local demand, such as baseball, softball, hockey and canoe/kayak slalom. Kasimati (2015) shows that these facilities were not simply abandoned because they were badly built. They became problematic because the host context had no realistic capacity to absorb them. That is a more structural failure than neglect. It is a mismatch between infrastructure and market.

Winter Games have often produced similar problems, sometimes more intensely. Tang et al. (2024) and Brown (2020) both note that highly specialised winter venues such as bobsleigh tracks, luge facilities and speed skating ovals are among the infrastructures most exposed to white-elephant risk. They are expensive, technically demanding, geographically constrained and difficult to repurpose.

Turin 2006 presents a mixed but telling case. Della Sala (2023) shows that the city's broader image and regeneration effects can be read positively in several respects, yet some sports facilities, most notably the Cesana bobsleigh track and the Pragelato ski jumps, became emblematic examples of post-Olympic fragility. These were not minor assets. They required substantial maintenance even when scarcely used. Their problem was structural, not episodic.

Sochi 2014 adds a different lesson. Azzali (2017) argues that part of the problem there lay not only in venue specialisation but in weak integration between the Olympic complex and the ordinary urban and tourist life of the city. The Adler Olympic Park risked functioning more as an event enclave than as a living district. This matters because it shows that multifunctionality alone does not guarantee success. A venue can fail because it is too specialised, but it can also fail because it sits in a context unable to sustain regular demand.

These examples point in the same direction. White elephants are not anomalies. They are foreseeable outcomes when planning, governance, use and urban integration remain misaligned.

1.4.4. Example of success

Not all Olympic legacies are negative, and it would be analytically lazy to suggest otherwise. Some cases show that long-term success is possible, though usually under stricter conditions than official narratives admit.

Barcelona 1992 is often cited as a positive legacy case. Nunan and O'Brien (2012) argue that its success depended less on the isolated performance of individual venues than on the broader urban transformation into which those venues were inserted. The Games were absorbed by a larger metropolitan project. That distinction matters. Success was not produced by the event alone, but by the relation between event and city.

Sydney 2000 offers another useful example. Lochhead (2005) and the later planning framework of Sydney Olympic Park suggest that continuity of use, district-scale development and long-term management planning helped avoid the isolation that has characterised weaker Olympic sites. The Olympic Park did not simply remain standing. It remained active.

The common feature of the more successful cases is not perfection but alignment. Venues tend to perform better when they are flexible, accessible, linked to a broader urban strategy and supported by a post-event function that has been considered before the Games rather than after them. Chen (2015) and Preuss and Plambeck (2021) both support this reading. Legacy is stronger when reuse is not improvised.

1.5. Legacy planning

1.5.1. Legacy planning

In contemporary Olympic studies, legacy is the concept through which the event is judged beyond its temporary duration. The term refers to the lasting effects generated by the Games, positive or negative, tangible or intangible, within the host city and territory. Toohey (2008) and Chen (2015) both show that this shift in evaluative

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language emerged precisely because short-term success had often coexisted with long-term disappointment.

Legacy, however, should not be treated as a naturally produced residue of Olympic investment. That assumption is misleading. A durable legacy is planned, negotiated, managed and, at times, revised. It has to be built into the project logic. Otherwise the concept becomes merely celebratory.

1.5.2. Types of Legacy

Legacy is not singular. Scheu et al. (2021) and Toohey (2008) both stress its plurality. Physical legacy concerns buildings, facilities and infrastructures. Urban legacy refers to changes in spatial structure, accessibility and regeneration patterns. Economic legacy concerns attractiveness, employment, investment and operating value. Social and cultural legacy involves participation, inclusion, symbolic identification and collective use. To these dimensions one should add managerial and institutional legacy, especially in cases where governance models, monitoring cultures and operating capabilities persist beyond the event, as Garavelli (2024) suggests.

This plurality is analytically useful because it prevents one-dimensional judgements. A city may achieve a strong urban legacy and a weak venue legacy. A venue may be economically active and socially thin. The categories should therefore be held together, but not collapsed into one another.

1.5.3. Legacy as a planned process

Chen (2015) makes a point that deserves emphasis: legacy should be incorporated from the earliest planning stages, not attached retrospectively once the event is over. This argument is more demanding than it first appears. It implies that design, post-event function, governance model and urban integration must be addressed as interconnected variables from the outset.

The first issue is definitional. What is the venue supposed to become after the Games? If that answer is absent or vague, later conversion is likely to be reactive rather than strategic. Davis (2020) shows how design itself is affected by this question. Capacity, internal layout, systems, accessibility and reconfiguration potential all depend on the seriousness with which future use is considered.

The second issue is managerial. A venue cannot be judged sustainable if nobody has clearly addressed who will operate it, under what objectives, with what revenue model and through which performance criteria. Preuss and Plambeck (2021) are especially relevant here because they tie legacy directly to measurable long-term use rather than symbolic intent.

The third issue is urban. Even a well-designed venue struggles if it is territorially isolated. A building inserted into a transforming district, supported by accessibility and complementary functions, has a much stronger chance of stabilising its post-event role.

Legacy planning, then, is not a decorative chapter within the Olympic dossier. It is the practical condition of post-event success.

1.5.4. Usage as a measure of legacy

One of the clearest insights in recent literature comes from Preuss and Plambeck (2021): the legacy of a venue is inseparable from its use. This seems obvious, yet much Olympic rhetoric avoids stating it so directly. A venue does not become a positive legacy because it exists. It becomes one if it remains active in forms compatible with its cost, scale and urban role.

Use can be observed through several indicators: annual event frequency, diversity of activities, utilisation rates, revenue generation and continuity over time. When legacy is read through use, it stops being abstract. It becomes performative and measurable.

For multifunctional arenas this issue is particularly sharp. In principle, such venues can host sporting events, concerts, shows, conventions and entertainment formats. That potential is real, but it is not self-executing. It depends on design flexibility, managerial competence, market receptivity and territorial integration. A multifunctional arena may be more adaptable than a highly specialised Olympic venue, but it still has to prove that adaptability through real use patterns.

1.6. Theoretical implications for the analysis of Olympic arenas

The discussion developed so far points toward a more precise analytical frame for Olympic arenas. These venues are not neutral containers of sport. They are infrastructures through which the relation between mega-event logic, sustainability and legacy becomes visible in concrete terms.

Olympic arenas are especially interesting because they sit in an intermediate position. They are less specialised than certain Winter Games facilities, yet still highly exposed to oversizing, operating burden and post-event uncertainty. Preuss and Plambeck (2021) and Tang et al. (2024) both help clarify this point. Flexibility improves the prospects of long-term success, but flexibility alone does not settle the question.

What matters is the relation between Olympic use and ordinary use. A venue that functions at peak intensity during the Games still has to find a viable lower-intensity equilibrium afterward. The real challenge lies there. Davis (2020) and Chen (2015) show that this transition depends on four closely related axes: consistency between capacity and post-event demand, economic-managerial viability, urban integration and the ability to produce a durable and monitorable legacy.

This perspective is directly relevant to Unipol Dome. The venue was conceived for the Milano-Cortina 2026 Winter Games, but its meaning cannot be exhausted by that temporary role. The critical question is whether it can consolidate itself as a multifunctional, urban and economically sustainable infrastructure once the Olympic phase is over. That question cannot be answered by looking only at architecture or delivery. It requires a broader life-cycle reading.

For this reason, the present thesis adopts the following conceptual orientation: an Olympic arena should be evaluated not only through construction quality or compliance with event requirements, but through the coherence between post-event demand and infrastructure, the sustainability of its management model, the depth of its urban integration and the durability of the legacy it may generate over time.

1.7. Concluding remarks

The Olympic Games are temporary. Their infrastructures are not. That disparity is the point from which the whole chapter has moved.

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What emerges is a less celebratory and more exacting interpretation of Olympic development. The Games can accelerate investment, reshape territories and generate strategic visibility. They can also leave behind expensive, weakly integrated and poorly used assets. The difference is not accidental. It depends on how design, construction, management and post-event use are connected.

The evolution of the Olympic model has made this increasingly clear. Legacy is no longer a secondary concept; it is the main criterion through which Olympic infrastructure is judged. Sustainability, in the same way, cannot be confined to environmental rhetoric. It has to include economic viability, social accessibility, urban compatibility and management capacity. When these dimensions fail to align, the result is often some version of the white elephant.

Olympic arenas condense all of these tensions. They are potentially flexible, potentially active, potentially capable of generating a durable urban role. Potential, though, is a weak category if it is not supported by realistic planning and long-term operation. That is why the case of Unipol Dome deserves to be studied not as a finished success, nor as a project to be judged prematurely, but as a venue whose long-term value depends on the quality of the transition from Olympic function to ordinary life.

This is the threshold on which the rest of the thesis is built. The next chapters move from the theoretical framework developed here to the specific context of Milano-Cortina 2026, then to the case study of Unipol Dome, and later to the comparative and evaluative tools needed to understand whether the arena can avoid the white elephant effect and consolidate itself as a sustainable infrastructure over time.

2. Milan-Cortina 2026 as a reference context

2.1. General framework of the Milan-Cortina 2026 Olympic and Paralympic Winter Games

The Milan-Cortina 2026 Winter Olympic and Paralympic Games mark the return of the Winter Games to Italy through a territorial model that departs rather clearly from the older image of the single host city. The event is distributed across a wide geography that includes Milan, Cortina, Valtellina and Val di Fiemme, extending across Lombardy, Veneto and the autonomous provinces of Trentino-Alto Adige. This is not a marginal organisational detail. It shapes the entire structure of the event, from mobility and coordination to infrastructure planning and venue legacy.

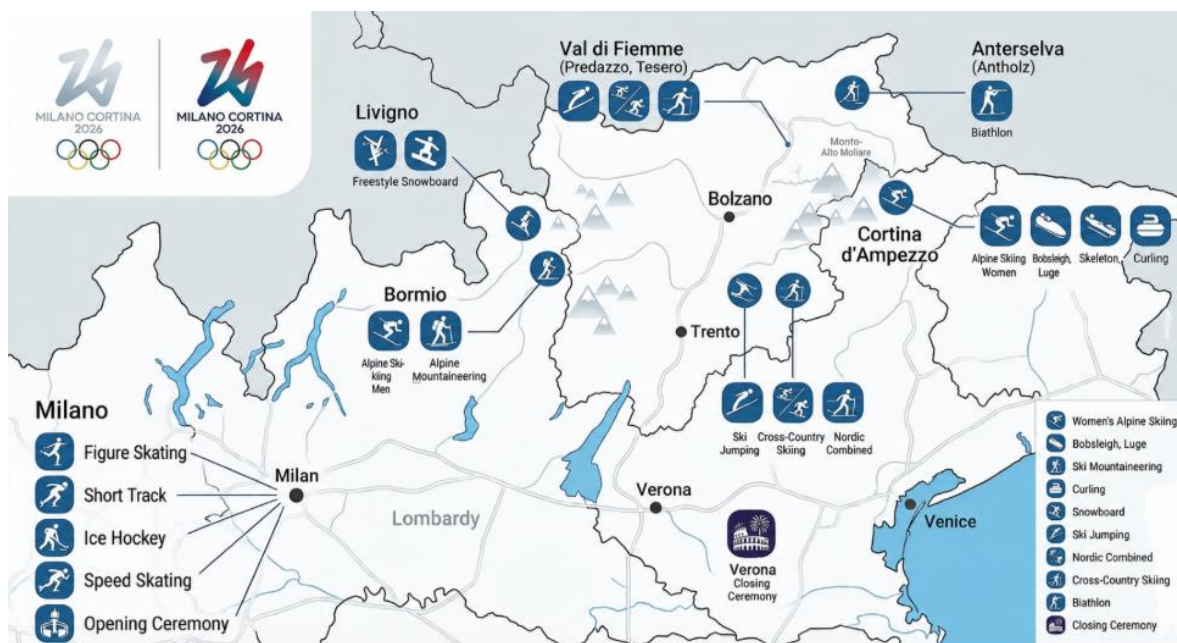


Image 1.1 - Territorial distribution of Milano Cortina 2026 Olympic venues and disciplines. Source: Olympic World Library

Institutional narratives present this configuration as a more prudent and territorially intelligent approach. The logic is easy to understand. Rather than concentrate the whole burden of the Games in one urban core, the model relies on several pre-existing territorial clusters, each associated with specific facilities, identities and sporting functions. IOC materials and the candidacy framework insist on this point, framing the Games as a polycentric system built around the enhancement of existing assets and a partial limitation of new construction. Garavelli (2024) reads this structure as one of the most distinctive features of the Milan-Cortina edition, while Russo (2025) underlines the extent to which it modifies the traditional governance logic of Olympic hosting.

That said, the distributed model should not be romanticised. The reduction of concentration does not mean the reduction of complexity. Quite the opposite. A Games system dispersed across multiple territories increases the need for institutional coordination, synchronised timelines, transport integration and operational reliability. It also raises the threshold of vulnerability. Delays, misalignments and procedural frictions no longer affect a single urban theatre; they reverberate across a wider network of sites, works and actors.

This is one reason why Milan-Cortina 2026 matters for the present research. The Games are often described through the language of innovation, sustainability and territorial balance. Those claims are analytically relevant, but they cannot be accepted as self-validating. They have to be tested through the way the venues are actually conceived, delivered and inserted into their long-term contexts. The Olympic event remains temporary. The infrastructures created or reconfigured for it do not. The meaning of the Milan-Cortina model therefore lies less in the elegance of its institutional narrative than in the durability of the material and operational arrangements it leaves behind.

A second aspect deserves attention. Within the public discourse surrounding the Games, sustainability and legacy are not presented as external objectives added after the fact. They are treated as central parts of the event's identity. The dossier and subsequent institutional communications repeatedly suggest that Milan-Cortina 2026 aims to represent a more restrained Olympic model, less dependent on monumental new construction and more attentive to the future use of venues and territorial assets. That language is not irrelevant. It reveals the extent to which the Olympic paradigm has changed. The question, though, remains open: whether those declarations correspond to a solid long-term structure or merely to an improved vocabulary of legitimacy.

This chapter addresses that question by treating Milan-Cortina 2026 not as a background scene, but as the operative context within which Unipol Dome, takes shape. The arena does not emerge in a vacuum. It belongs to a larger Olympic, institutional and territorial configuration. Understanding that configuration is necessary before moving toward the case study itself.

2.2. The significance of the Milan-Cortina 2026 context for the present research

The relevance of the Milan-Cortina 2026 context to this thesis is methodological before it is descriptive. Unipol Dome cannot be interpreted as an isolated object, nor as a venue whose long-term prospects depend only on its architectural and technical qualities. It is the product of a wider set of Olympic decisions, deadlines, actors, territorial strategies and governance arrangements that strongly influence both its temporary Olympic role and its post-event horizon.

This clarification matters because there is a recurrent risk in venue studies: to analyse the building as if it were self-sufficient. It rarely is. In the present case, the Olympic framework affects at least four dimensions of interpretation.

The first concerns temporary peak use. Olympic venues are not built for ordinary demand alone. They are designed to withstand a short period of maximum intensity, with strict requirements concerning safety, capacity, visibility, accessibility and operational readiness. That peak condition tends to shape decisions whose effects continue long after the Games have ended.

The second concerns time pressure. Olympic infrastructure is governed by fixed deadlines that are politically non-negotiable. This compresses planning and implementation, especially where construction or completion must align with test events, logistical systems and the opening calendar. Garavelli (2024) treats this feature as intrinsic to the Olympic project logic, while SIMICO's public monitoring framework makes the operational consequences of such timing pressures particularly visible.

A third dimension concerns sustainability and legacy. The Games generate not only organisational expectations but evaluative criteria. Venues are now judged, at least in official discourse, not only by their ability to host competition, but by their capacity to contribute to a longer and broader trajectory of territorial value. This is directly relevant to the present research, since the central question is

whether Unipol Dome can avoid the logic of underuse and consolidate a durable role after the event.

The fourth dimension is urban. The arena is inserted into an ongoing process of territorial transformation. Its meaning cannot be read only through its Olympic allocation. It has to be related to the wider urban dynamics of Milan and, more specifically, to the regeneration trajectory of Santa Giulia. The Olympic context, in other words, does not simply add a temporary function to the arena. It frames the conditions through which the venue is delivered, legitimised and expected to operate.

For these reasons, Chapter 2 does not serve merely as an institutional introduction. It establishes the interpretative perimeter of the thesis. Without the Milan-Cortina framework, Unipol Dome would appear as a contemporary multifunctional arena among others. With that framework, it becomes a more specific object of inquiry: a venue built within a mega-event logic but expected to survive beyond it as a stable urban and managerial infrastructure.

2.3. The organizational and territorial model of the Games

The territorial architecture of Milan-Cortina 2026 is one of its most visible distinguishing traits. Instead of concentrating competitions in a single metropolitan core, the Games are distributed across several clusters with different spatial identities and functional roles. Milan hosts the more urban and media-visible components. Alpine territories accommodate disciplines linked to mountain settings and winter sports traditions. The structure is therefore both functional and symbolic. It reflects an attempt to align venue location with territorial vocation.

From an institutional point of view, this model has been framed as a way to reduce unnecessary new construction and to rely, where possible, on existing territorial resources. That claim is coherent with the broader Olympic shift toward reuse and legacy-oriented planning. Yet the model also carries a more ambiguous side. Polycentrism is often described as efficient because it avoids the concentration of costs and burdens. What it actually does is redistribute them across a much more articulated network.

The consequences are immediate. Coordination becomes more demanding. Local administrations, regional authorities, venue operators, infrastructure managers and central Olympic bodies must interact across a wider geography and through more

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differentiated institutional settings. Transport gains unusual importance. In a concentrated Games model, mobility is difficult. In a dispersed model, it becomes decisive. Russo (2025) is particularly useful here, because he emphasises how the success of the Milan-Cortina edition depends not only on the readiness of individual venues but on the coherence of the network linking them.

SIMICO's official documentation confirms this systemic exposure. The public work framework includes not only sports venues, but also transport infrastructure, accessibility interventions and implementation schedules distributed across multiple territories. The "Open Milano Cortina" platform presents this complexity in quantified terms, reporting a broad programme of sports and transport interventions with periodic updates on timing, authorisation and implementation status. The significance of this is straightforward. The Games do not operate as a collection of separate projects. They function as an interdependent programme in which venues are only one component, albeit a highly visible one.

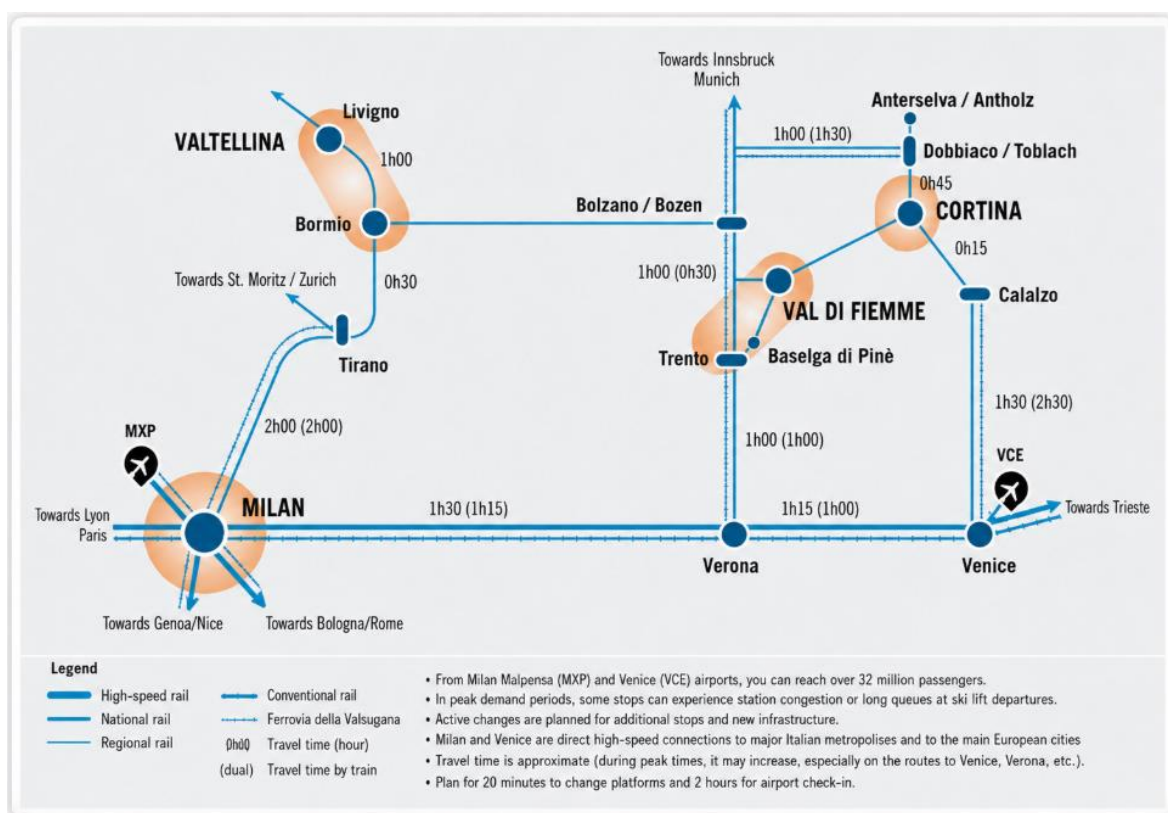


Image 1.2 - Transport connections and accessibility network of the Milano Cortina 2026 Olympic clusters. Source: Olympic World Library

This has a direct implication for Unipol Dome. The arena cannot be evaluated only through the lens of its own design, cost or future use. Its performance also depends on the degree to which it fits into the Milanese cluster and, more broadly, into the operational logic of the Games as a whole. The venue is a distinct asset, but not an autonomous one. It belongs to a larger Olympic machine, and its success is shaped partly by how well that machine holds together.

At the same time, the distributed nature of the Games strengthens the analytical importance of the Milan cluster. In a polycentric edition, the most visible urban venues tend to acquire a representative function that exceeds their direct sporting role. They become emblematic of the event's modernity, institutional credibility and legacy ambitions. Unipol Dome enters the thesis precisely through this threshold: as a specific venue, but also as a strategic fragment of a much larger territorial model.

2.4. Governance, works and implementation framework

The governance structure of Milan-Cortina 2026 is articulated, layered and, at times, deliberately segmented. This is not unusual for Olympic events, but in this case the distinction between organisational management and infrastructural implementation is especially sharp.

On one side stands the Milano Cortina 2026 Foundation, responsible for the organisation, promotion and communication of the Games in relation to the IOC framework. On the other side stands SIMICO, the infrastructure company tasked with coordinating and monitoring a significant share of the Olympic works. Garavelli (2024) reads this dual structure as one of the key features of the Italian organisational model, while SIMICO's own materials insist on the operational necessity of such separation.

The distinction is analytically useful because it reveals two temporalities that coexist but do not coincide. The first is the temporality of the event. It is short, concentrated and tied to Olympic performance. The second is the temporality of infrastructure. It is much longer, extending from design and delivery to post-event operation. Confusing the two has often generated problems in previous Olympic cases. A venue can be delivered successfully for the Games and still remain weak in legacy terms if the

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governance logic ends with the event rather than continuing into long-term management.

This is why governance cannot be treated as a merely organisational backdrop. It is one of the conditions through which legacy becomes possible or remains fragile. The venue stays after the event. The governance structure capable of supporting its post-event life must therefore either pre-exist or be built in time. If it appears too late, the Olympic deadline may be met while the long-term model remains underdefined.

SIMICO’s public framework places strong emphasis on transparency, legality, traceability and monitoring. The “Open Milano Cortina” platform is presented not simply as an information instrument, but as a tool of public visibility and accountability. That is relevant in itself. The platform suggests that part of the intangible legacy of the Games may lie in the attempt to build a more controlled and publicly legible implementation process. The same logic is visible in the institutional protocols linked to anti-mafia control, worksite legality, safety and administrative supervision. This part of the governance architecture is less spectacular than venue design, but more revealing than it first seems.

The implication is broader than it appears. Sustainability, in this context, cannot be reduced to the environmental profile of a building or to the later use of a venue. It also concerns the credibility of the implementation process. A Games model that claims to be more sustainable but fails on legality, monitoring or procedural reliability would remain internally inconsistent. Russo (2025) and Garavelli (2024) both point toward this wider interpretation, even if from different analytical angles.

For the purposes of this thesis, the governance framework matters because it helps explain how Unipol Dome is positioned between event delivery and long-term operation. The arena is not only a private or architectural project. It is part of a larger institutional field in which public oversight, Olympic necessity, territorial planning and future facility management overlap. That overlap is one of the reasons the case is analytically rich. It is also one of the reasons it is exposed.

Subject	Main Role	Importance
International Olympic Committee (IOC)	Overall direction of the Olympic system and allocation of the Games	Defines the international framework of reference

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Milano Cortina 2026 Foundation	Event organization, promotion, and communication	Management of the temporary event
SIMICO	Delivery, coordination, and monitoring of many Olympic projects and facilities	Infrastructure and implementation framework
Local authorities and public administrations	Planning, permitting, and local coordination	Territorial integration and legacy development
Private operators	Investment, development, and potential management of selected venues	Relevant to the post-event business model
Future venue operators	Operations, facility management, and programming of venue use	Central to long-term sustainability

Table 2.1 - Main actors involved in the governance and long-term management of Milano Cortina 2026 Olympic venues. Source: author’s elaboration

2.5. Milan-Cortina 2026 between declared sustainability and expected legacy

Within the official narrative of Milan-Cortina 2026, sustainability and legacy occupy a conspicuous place. Institutional documents, public communications and project reporting insist on the idea that these Games should represent a more measured and responsible model, less dependent on monumental expansion and more attentive to the use of existing assets and the durability of outcomes. Russo (2025) and SIMICO’s published materials both reflect this orientation quite clearly.

This language is consistent with the broader Olympic shift described in the previous chapter. The era in which grandeur alone could function as a sufficient justification has largely passed. Cost exposure, white elephant risk and public scepticism have forced both host territories and the IOC toward a more cautious

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vocabulary. Reuse, adaptability and lasting value now appear as central criteria of legitimacy.

Still, the existence of that discourse should not be mistaken for proof. This is where the chapter needs to take a more critical position. Declared sustainability is not the same thing as verified sustainability. The first belongs to strategy, communication and institutional aspiration. The second belongs to the actual behaviour of projects over time. A Games edition may present itself as sustainable and yet produce results that are uneven, contradictory or fragile once the venues begin to operate under ordinary conditions. Chen (2015) is especially useful on this point because he treats legacy as a hypothesis to be tested rather than a label to be adopted.

The same distinction applies to legacy. The fact that an event invokes long-term value does not mean that such value has already been produced. Legacy is often announced before it is demonstrated. In analytical terms, that is not a flaw in language; it is a reminder that legacy should be treated as a prospective condition rather than an accomplished fact. This is particularly true for newly built venues, whose post-event role remains structurally uncertain until actual operation begins to stabilise.

For venues, the test becomes more specific. Three levels of verification matter most. The first concerns the consistency between Olympic function and post-event use. The second concerns the economic and managerial sustainability of the venue across its life cycle. The third concerns territorial and urban integration. Preuss and Plambeck (2021) and Tang et al. (2024) both support this kind of reading, even though their emphasis differs. A venue may be well aligned with one of these conditions and weak in another. That is precisely why legacy should not be handled as a generic summary category.

In this sense, Milan-Cortina 2026 is a particularly useful context for research. It presents itself as a more responsible Olympic edition, one that claims to have learned from earlier excesses. That claim deserves to be taken seriously, but not uncritically. The real analytical task is to verify how far the rhetoric of sustainability and legacy is matched by venue logic, implementation processes and future operating conditions. Unipol Dome becomes relevant here because it sits exactly at this intersection: it is one of the projects through which the declared ambitions of the Games are expected to become materially visible.

2.6. The venues of Milan and the strategic role of Unipol Dome

Within the broader Milan-Cortina system, the Milan cluster holds a particularly strategic position. It hosts some of the most visible and symbolically charged urban venues of the event, and in doing so it contributes to the public face of the Games more directly than many of the alpine sites. Official competition materials indicate that Milan includes facilities such as the Milano Santa Giulia Ice Hockey Arena and the Milano Ice Park, both central to the sporting programme of the urban cluster.

Among these, Unipol Dome stands out for a precise reason: it is not conceived as a narrowly Olympic structure whose relevance would likely decline after the event. From the outset, it has been described as a multifunctional venue intended to continue operating through sport, entertainment and large-scale events once the Games have ended. Olympics-related materials, along with project sources such as Arup, Lendlease and David Chipperfield Architects, converge on this point. The arena is presented not merely as a competition site, but as a permanent addition to Milan's event and urban infrastructure.

This is exactly what makes it significant for the present research. If the thesis were centred on a highly specialised winter venue, the main question would revolve around conversion difficulty. In the case of Santa Giulia, the issue is more subtle. The arena begins from a stronger formal position because multifunctionality, metropolitan location and district-scale regeneration all suggest higher adaptability. Yet that apparent strength should not lead to complacency. A multifunctional arena can still become weak if its long-term use remains thinner than expected, if its operating burden proves too heavy, or if its urban embedding remains incomplete.

What matters, then, is the passage from declared vocation to demonstrated performance. The arena's Olympic role is clear enough. It hosts ice hockey within the Milanese cluster. Its post-event role, however, remains a question to be explored rather than an answer already secured. The venue is expected to become part of the wider event ecosystem of Milan and of the regeneration trajectory of Santa Giulia. Whether it will do so effectively depends on conditions that exceed the event itself.

Three aspects make this especially relevant. The first concerns design. The arena was conceived from the beginning as a multifunctional venue, not as a single-purpose Olympic shell. The second concerns delivery and governance. The project sits at the

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intersection of private initiative, Olympic necessity and public-interest expectations. The third concerns long-term operation. A building can be delivered as planned and still fail to consolidate a convincing legacy if its ordinary use remains too weak or too discontinuous.

For this reason, Unipol Dome is not just one more Olympic venue within the Milan cluster. It is one of the clearest sites through which the broader questions of this thesis become tangible. It condenses the tension between temporary Olympic demand and long-term urban use, between infrastructural delivery and legacy expectation, between official sustainability claims and the slower, more demanding test of ordinary operation.

3. Research methodology and criteria for analysis

3.1. Research objectives and research questions

Once the theoretical framework on Olympic mega-events, venue legacy and long-term sustainability has been defined, a methodological clarification becomes necessary. The object of this thesis is not the Olympic Games in general, nor the abstract category of sports infrastructure. The research is narrower and, for that very reason, more demanding. It focuses on the long-term sustainability of a multifunctional arena developed for a mega-event and later expected to operate under ordinary conditions. In this case, the arena in question is Unipol Dome.

The central issue can be stated without ambiguity: how can a venue built for a major sporting event avoid drifting toward underuse and instead consolidate itself as a durable urban and managerial asset? That question carries several others within it. It requires attention to design choices, construction conditions, operating models, market demand, urban integration and governance. A venue does not become sustainable because one of these dimensions performs well in isolation. The problem is relational. The thesis is built on that assumption.

From this premise, four research objectives are derived. The first is to clarify how the Olympic context, and more specifically the Milano-Cortina 2026 framework, affects the genesis, role and constraints of Unipol Dome. The second is to analyse the arena not as a finished object, but as a project whose long-term value depends on technical, functional, economic and territorial conditions. The third is to compare the Milanese case with selected benchmark venues that have shown stronger post-event trajectories, so as to identify recurring patterns rather than isolated anecdotes. The fourth is to translate the analytical findings into an operational structure composed of

indicators, evaluative criteria and strategic scenarios capable of supporting a reasoned judgement on the arena's long-term sustainability.

These objectives lead to a set of research questions that guide the entire thesis. How does the Milano-Cortina 2026 context influence the design logic and future role of Unipol Dome? Which conditions most strongly affect the post-event success or failure of a multifunctional Olympic venue? Which benchmark cases are genuinely useful for interpreting the Milanese arena, and why? Which indicators can support a long-term assessment of sustainability and legacy? Which scenarios and strategic directions appear most plausible once the evidence is reorganised into an evaluative framework?

The methodological value of these questions lies in the fact that they do not treat the arena as a merely descriptive case. They force the research toward a more structured outcome.

3.2. General methodological approach

The methodological approach adopted in this thesis can be described as qualitative-comparative, supported where necessary by structured evaluative tools and selective quantitative reasoning. This choice is not arbitrary. It arises from the nature of the case itself. Unipol Dome is a recently developed venue whose long-term post-Olympic performance cannot yet be observed in full empirical depth. A methodology based exclusively on ex post operational data would therefore be premature and, to some extent, misleading.

For this reason, the research is organised around three interconnected methodological levels.

The first level is the in-depth study of the main case. Unipol Dome is analysed as a concrete project embedded in a specific Olympic and urban context. This allows the thesis to reconstruct the arena's origins, technical and functional profile, ownership and delivery logic, expected use model and territorial position. The goal is not simply to describe the venue, but to identify the conditions that may later support or weaken its long-term performance.

The second level is comparative. Selected benchmark venues are used not as decorative examples of "success", but as analytical instruments. Their value lies in the possibility of observing how long-term sustainability is shaped when design, transformation and post-event operation remain aligned over time. As later

chapters make clear, the benchmarks are useful because they render certain structural patterns more legible: early anticipation of post-event use, transformation capacity, operational continuity and realistic integration into the surrounding urban system.

The third level is strategic and synthetic. The evidence gathered through case analysis and comparison is not left in narrative form. It is reorganised into indicators, evaluative matrices and scenario-based reasoning. This step matters. A descriptive comparison may clarify similarities and differences, but it does not by itself generate a usable framework for judgement. The methodological progression of the thesis therefore moves from interpretation toward evaluation, and from evaluation toward strategic reading.

Underlying these three levels is a life-cycle perspective. The arena is read through three phases: design, construction and in-use operation. This tripartite structure is methodologically consistent with the theoretical position developed in the previous chapters, namely that legacy is not an after-effect that appears once the event has ended, but a condition prepared in the design phase, affected by delivery dynamics and ultimately tested through operation. That same logic later becomes the basis of the evaluative model developed in Chapter 6.

3.3. The main case study: Unipol Dome

The choice of Unipol Dome as the main case study is justified by a set of reasons that are both contextual and methodological. The first concerns temporal relevance. The arena is directly linked to the Milano-Cortina 2026 Winter Olympic and Paralympic Games and therefore belongs to a still-evolving Olympic framework rather than to a closed historical case. The second concerns its territorial role. It is part of a strategic area of transformation within Milan and cannot be understood independently from that wider urban process.

A third reason lies in the venue's multifunctional ambition. Unipol Dome is not conceived as an exclusively Olympic or mono-functional facility. It is intended to continue after the Games as a large indoor arena for sport, concerts, entertainment and major events. This makes it particularly suitable for research on legacy, because the core issue is not whether the venue can technically survive after the event, but whether it can stabilise a credible long-term use model. That is a more difficult and more interesting question.

A fourth reason concerns the investment and management dimension. The arena is especially relevant because it stands at the intersection of Olympic delivery, private-

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sector logic, urban regeneration and future operational sustainability. This allows the thesis to move beyond purely architectural analysis and to address the broader conditions that tend to determine whether a venue becomes absorbable in the long term or remains exposed to under-consolidation.

A fifth and final reason concerns the structure of the research itself. Unipol Dome is not used because it offers a complete and already verifiable post-event record. It is used because its current condition makes evaluative reasoning necessary. The arena is precisely the kind of case in which long-term sustainability cannot yet be inferred from actual mature operation and must therefore be approached through a combination of project analysis, benchmark comparison and structured assessment.

3.4. Criteria for selecting comparative benchmarks

Once the main case has been established, the role of comparative benchmarks must be clarified carefully. The benchmark venues are not treated as parallel research subjects equal in status to Unipol dome. They are used to illuminate structural conditions that may also matter for the Milanese case, especially in relation to post-event use, legacy planning and long-term operational viability.

Their selection follows four main criteria:

- The first is functional comparability. The chosen cases had to involve covered venues or facilities sufficiently comparable in terms of scale, complexity or multi-use logic to make comparison meaningful. Exact formal similarity was not required; in fact, that would have been too restrictive. What mattered more was the possibility of observing comparable legacy problems and solutions.
- The second criterion is the relationship with a major international sporting event, preferably an Olympic one. This requirement is essential because the thesis is concerned not only with venue management in general, but with the specific tension between temporary event use and long-term ordinary operation. Benchmark cases had therefore to offer evidence of how this transition had been handled over time.
- The third criterion is legacy quality. The selected cases had to show signs of positive post-event performance, not in a rhetorical sense, but in terms of continuity of use, diversified programming, urban or community relevance, and the absence of strong white-elephant symptoms. The purpose was not to

construct ideal models, but to identify venues in which certain strategic alignments had worked better than in weaker Olympic cases.

- The fourth criterion is the availability of information. This may sound secondary, but it is not. Comparative analysis requires a sufficient documentary base to support a reliable reconstruction of design choices, governance conditions, transformation processes and post-event operation. Cases with weak information availability would have reduced the analytical solidity of the thesis.

Taken together, these criteria explain why the benchmark analysis is not intended as a simple contrast between “successful” and “unsuccessful” venues. It is used instead to extract transferable insights from cases in which long-term performance appears stronger and more stable. This is what allows the comparison to function later as the analytical base of the evaluation framework rather than as a purely illustrative excursus.

3.5. Information collection and analysis techniques

The research is based on a plurality of sources, combined in order to build a coherent and verifiable interpretative framework. No single source type would have been sufficient on its own. This is particularly true for a case such as Unipol dome, where the venue is recent, the operational future is still partly open, and the available information is uneven across different dimensions of the project.

The first source category is scientific and academic literature. This literature provides the conceptual basis for the thesis, especially in relation to mega-events, sustainability, white elephants, legacy, post-event use and management models. Without this body of work, the case study would risk being reduced to a journalistic or project-specific narrative. The literature is what makes comparative interpretation possible.

The second category is institutional and official documentation. This includes Olympic materials, governance-related documents, public monitoring platforms, project communications and venue-related sources linked to the Milan-Cortina 2026 context and to the selected benchmark cases. These sources are indispensable for reconstructing declared aims, implementation settings, ownership arrangements and planning frameworks. They are less reliable, however, when it comes to self-assessment. For that reason they are used critically rather than descriptively.

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The third category is technical and project documentation, where publicly available. In the case of Unipol Dome and of the benchmark venues, this includes architectural material, engineering descriptions, design narratives and operational information useful for understanding venue configuration and expected use conditions. The availability of this documentation is not uniform, which partly explains the need for triangulation across multiple source types.

The fourth category consists of the author's own analytical elaborations. These include comparative tables, synthetic matrices, KPI structures, scenario schemes and the evaluative framework developed in the second part of the thesis. They are the instruments through which heterogeneous information is reorganised into a more explicit analytical form.

The method of analysis follows a process of comparative reading and critical synthesis. Information is first collected and classified into homogeneous categories. It is then interpreted across recurring dimensions such as design logic, delivery conditions, governance, post-event use, operating sustainability and urban integration. At a later stage, the material is translated into diagrams, indicators and strategic scenarios. This sequence is deliberate. It avoids the jump from raw information to premature judgement.

3.6. Search limits

Like any research dealing with a contemporary and partly evolving case, this thesis operates within a set of limitations that should be stated openly. Making them explicit is not a formality. It defines the perimeter within which the results can be interpreted.

The first limitation concerns the case itself. Unipol dome is a newly developed venue and does not yet offer a long operational history from which robust post-event conclusions could be drawn. This means that part of the evaluation developed later in the thesis, especially in relation to long-term use and management, necessarily relies on ex ante reasoning based on project information, official documentation, benchmark evidence and public sources rather than on mature in-use data. Any claim to predictive certainty would therefore be methodologically unserious.

A second limitation concerns comparability. Benchmark venues can illuminate structural patterns, but they do not provide direct equivalence. Each arena is shaped by a different territorial setting, demand profile, governance structure, market position and historical trajectory. The comparison is therefore heuristic rather

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than mechanical. It supports interpretation. It does not eliminate contextual difference.

A third limitation concerns the instability of large projects and mega-event contexts. Costs, schedules, governance arrangements, operational expectations and public narratives may shift over time. This is especially true before the Olympic event has taken place and before the venue has fully entered ordinary operation. For this reason, the findings of the thesis must be read as grounded within the currently available information framework rather than as definitive statements immune to later revision.

These limitations simply define its epistemic position. The thesis proposes a structured and transparent way of evaluating a venue whose long-term trajectory is still information.

3.7. Concluding remarks

This chapter has defined the methodological architecture of the thesis. The research is built around a main case study, supported by comparative benchmarks and progressively translated into evaluative and strategic tools. That structure reflects the nature of the problem under examination. Unipol Dome is not being studied merely as a completed building. It is being studied as a venue whose long-term sustainability depends on the interaction between design, delivery, governance, use and urban embedding.

The life-cycle approach adopted here is especially important because it prevents the analysis from collapsing into a single-phase reading. A venue may appear persuasive at project level and later prove weak in operation. It may be delivered successfully and still remain exposed to underuse. It may possess a strong technical profile and yet fail to consolidate a stable post-event role. The methodology has been designed precisely to hold these temporal relations together.

On this basis, the next chapter can move into the substantial core of the case study, examining Unipol Dome in its project genesis, technical and functional characteristics, economic structure and urban role. Later chapters will then transform that analysis, together with the benchmark evidence, into a more explicit framework for long-term evaluation and strategic interpretation.

4. Unipol Dome: genesis, characteristics and prospects of use

4.1. Premise

Unipol Dome is the central case study of this thesis because it condenses, within a single project, several of the tensions that usually remain dispersed across the Olympic debate. It is a newly built venue tied to a fixed mega-event deadline. It is embedded in a wider urban regeneration process. It is presented, from the outset, not as a temporary Olympic shell but as a long-term multifunctional arena expected to remain active after the Games. That combination makes it analytically fertile, but it also makes it exposed. A venue of this kind is persuasive on paper almost by definition. The harder question is whether the conditions that support its later operation are equally convincing.

Official and project-related sources describe the arena as the largest new indoor venue in Italy for concerts, sport and major live events, which means that its long-term value cannot be judged through Olympic use alone. The project must be read in relation to what comes after: continuity of programming, operating absorbability, technical resilience and urban integration. That is where legacy stops being a slogan and becomes a test.

The chapter adopts a deliberately critical stance. Unipol Dome should not be described as an already successful legacy project simply because it was conceived with a post-event narrative. Many Olympic venues have been accompanied by similar promises. The issue is narrower and more demanding: whether the arena's design logic, delivery structure, technological profile and territorial setting are genuinely aligned with the conditions required for durable use.



Image 4.1 - External view of Unipol Dome within the Milano Santa Giulia urban context. Source: Itinera S.p.A.

4.1.1. Analytical reading of the case study across three phases

The case is examined through three interconnected phases: design, construction and in-use operation. This is not simply a formal division of the chapter. It reflects the methodological position adopted throughout the thesis, according to which the long-term performance of an Olympic venue is not produced at one isolated moment, but progressively shaped through earlier decisions, implementation constraints and later operating conditions. Tang et al. (2024) are especially helpful in supporting this life-cycle reading, while Preuss and Plambeck (2021) and Chen (2015) clarify why legacy should be interpreted as a performance issue rather than a symbolic label.

The design phase is read through the initial concept of the arena, its intended multifunctionality, ownership and delivery structure, spatial configuration and technological ambition. The construction phase is considered through scheduling pressure, procurement and delivery conditions, implementation constraints and the relationship between time, cost, technical quality and environmental measures. The in-use phase, which remains partly prospective, is interpreted through the expected operation of the arena after the event, its capacity to sustain repeated and diversified use, its integration into the wider Santa Giulia district and its exposure to underuse if the post-event model fails to consolidate.

This tripartite reading matters because it avoids a common distortion. Large venues are often judged through their final image: size, architecture, technical ambition, symbolic relevance. Those elements matter, but they are not enough. A venue can appear strong in design terms and later prove fragile if its delivery is strained or if its ordinary use does not match its scale. The life-cycle structure is therefore not an abstract methodological preference. It is the only way to hold together the different temporal layers through which the arena's legacy will actually be determined.

4.2. Project origin, client structure and ownership

The institutional shape of Unipol Dome became more defined in 2021, when Milano Santa Giulia S.p.A. and Risanamento S.p.A. signed a binding Framework Agreement with EVD Milan S.r.l., a company belonging to the CTS Eventim Group. That agreement did not merely authorise the construction of a new building. It already positioned the arena within a dual horizon: Olympic use in the short term and a broader programme of national and international sport and entertainment events in the longer term. In other words, the post-event function was not added later as a corrective narrative; it was embedded in the initial client and operator structure.

The same agreement specified that EVD would acquire from Milano Santa Giulia a reclaimed and urbanised plot of around 50,000 m² within the redevelopment area, and that EVD itself would build and subsequently manage the arena. This point is more important than it may first appear. It means that the venue was not conceived as a standalone Olympic facility delivered by public bodies and only later transferred to a future operator. The long-term operational subject was already present in the development phase, and the arena was contractually tied to the wider transformation of the district from the beginning.

Ownership should therefore be read through this hybrid configuration. Unipol Dome is not a conventional public Olympic venue, yet it is not a neutral private development either. It sits at the intersection of three logics: Olympic delivery, private event-market investment and urban regeneration. This makes the case analytically richer than many past Olympic facilities whose weakness stemmed precisely from the absence of a clear long-term operator or from an excessively late transition from event governance to ordinary management.

A later development confirms this reading. In January 2026, Unipol signed a long-term naming-rights agreement with CTS Eventim, and the venue, originally named Arena Santa Giulia, was renamed Unipol Dome from spring 2026 until December 2035, while

ownership remained linked to the Eventim group. Naming rights are not just a branding device here. They are evidence that the arena had already entered a commercial positioning process before the Olympic event itself, reinforcing the idea that its identity was being constructed as a long-term metropolitan venue rather than as a temporary Olympic container.

4.3. Investment framework: private capital, public support and cost structure

The economic structure of Unipol Dome is more layered than a single headline investment figure might suggest. The clearest primary-source estimate comes from CTS Eventim, which in 2021 indicated a total investment of €180 million for the arena, with works then expected to run from autumn 2022 to autumn 2025. That figure is useful because it establishes the initial scale of the project and confirms that the venue was conceived from the outset as a major long-term event asset rather than as a marginal Olympic facility.

That initial estimate, however, should be distinguished from the cost of the site itself. The Framework Agreement set the purchase price of the arena plot at €20 million plus VAT, with a staged payment structure: €2 million upon signing the Framework Agreement, €9 million upon the execution of the deed of sale, and the remaining €9 million upon the third anniversary of the sale or the final rehearsals of the arena, subject to the completion of related reclamation and infrastructure works. This arrangement shows that the financial architecture of the arena included not only the building as such, but also the prepared urban land on which it was to rise, and therefore part of the economic logic of the broader Santa Giulia redevelopment process.

A further financial layer emerged in 2025 through direct public support. In August 2025, Italian legislation authorised €21 million for that year “to ensure the functionality” of the work known as Arena Pala Italia Santa Giulia for the Milano-Cortina 2026 Olympic and Paralympic Games. In October 2025, a further law authorised an additional €30 million for 2025, explicitly in addition to the previously authorised funds, with the stated purpose of securing agreements for the long-term availability of the arena for national and international sporting events over a multi-year period. The official wording is revealing: public support was not framed as a generic contribution to private construction, but as an intervention tied both to Olympic functionality and to the longer-term public-interest availability of the venue.

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For this reason, the cost structure should be read on at least three distinct levels: the initial private investment estimate of €180 million, the €20 million plus VAT paid for the lot, and the later €21 million + €30 million of public resources authorised in 2025. Treating these items as if they belonged to a single undifferentiated total would be methodologically weak, especially because there is still no fully confirmed official public figure for the final all-in construction cost after completion. Some later secondary accounts discuss higher totals and additional disputes, but the safer analytical position is to separate the figures that are clearly documented rather than compress them into an uncertain final amount.

This economic configuration says something substantive about the arena. Private capital gave the project its initial drive, but private investment alone did not remain sufficient once Olympic delivery pressures intensified and the issue of long-term availability for events of public relevance became more explicit. The venue is therefore neither a fully private market object nor a traditional publicly financed Olympic asset. It belongs to a mixed regime in which commercial logic, event urgency and public-interest justification overlap. That overlap is not a side note. It is one of the reasons why the long-term assessment of the arena must remain attentive to operating burden, continuity of use and managerial sustainability.

4.4. Scheduling, construction phases and delivery process

The construction phase of Unipol Dome has to be read under the pressure of the Olympic deadline. This point cannot be softened because it affects the entire logic of delivery. The venue is not built within an open-ended process that can easily absorb delays, redesigns or prolonged negotiation. It is built against a fixed international calendar. In mega-event settings, that condition changes everything: sequencing, procurement, contractor coordination, commissioning and risk exposure. The literature on Olympic venue construction has long insisted on this. Sun et al. (2008) show how compressed timeframes intensify the need for integrated control, while Garavelli (2024) makes the same issue visible from a governance perspective.

The arena's delivery process must therefore be understood as a high-pressure intersection between technical complexity and temporal rigidity. This is not a simple building. It includes a large event bowl, extensive hospitality spaces, integrated systems, external public areas, parking infrastructure and the additional requirements imposed by Olympic readiness. Delays would not affect only the formal completion of

the asset. They would also interfere with testing, rehearsals and operational preparation before the Games.

This pressure has an ambiguous effect. It can accelerate decisions and reduce the tolerance for procedural drift. It can also amplify vulnerability, especially where complexity, multiple contractors and ambitious technical systems are involved. That ambiguity belongs to the project itself. A rapid and coordinated delivery process may later be celebrated as proof of efficiency, but from an analytical point of view the question remains broader: what traces does that pressure leave on long-term performance? A building completed on time may still carry latent fragilities if implementation intensity has compromised robustness, maintainability or future operational flexibility.

For this reason, the construction phase is not treated here as a transitional interval between design and use. It is a substantive layer of the case. The way the building is delivered affects the way it can later operate.

4.5. Architectural and technical characteristics

Unipol Dome is conceived as a large elliptical indoor facility with a modular capacity of up to 16,000 spectators, including around 12,000 seats and 4,000 standing places depending on event configuration. Project materials describe it as the largest new indoor arena in Italy, explicitly designed to host both major sporting events and live entertainment. The building develops across eight levels and reaches a total gross floor area of approximately 77,000 square metres. It is complemented by an elevated outdoor square of over 10,000 square metres, intended to support flows, coordination, set-up activities and the broader operational interface between building and city.

Architecturally, the arena is organised around a podium over which three superimposed rings rise progressively, producing an amphitheatre-like volume. David Chipperfield Architects describes the external rings as wrapped in aluminium tubes that remain reflective by day and are animated at night through integrated LED strips. The internal arrangement includes parterre level, two levels of seating above it, and an upper level containing lounges and sky boxes, all linked by large atria and service areas. This is not simply a matter of formal expression. It shows that the arena was designed from the outset as a venue in which spectator experience, hospitality infrastructure and event versatility are all integral to the business model.

Additional project sources refine the technical picture. Clivet reports an outdoor area of almost 12,000 square metres and a separate multi-storey car park with

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approximately 2,750 spaces, designed in such a way as to allow potential future conversion to other uses. The same source underlines the goals of thermo-hygrometric control, acoustic and lighting performance, and high indoor air quality. Structural and fabrication data add another layer: Cimolai identifies dimensions of roughly 175 metres by 145 metres, a height of almost 40 metres, and the supply and installation of approximately 6,200 tonnes of steel for the arena and adjacent parking systems, including roof, suspended bodies, podium, garage and ancillary structures.

These numbers matter because they reveal the arena for what it is: a technically dense and materially demanding integrated system composed of envelope, structure, multimedia façade, hospitality infrastructure, podium, external spaces, parking and environmental systems. This reinforces the point that the arena's long-term sustainability will depend on whether such complexity can be continuously and economically absorbed through use.



*Image 4.2 - Construction phase of Unipol Dome in the Milano Santa Giulia redevelopment area.
Source: The Plan*

4.6. Technological features

The technological profile of Unipol Dome is one of the clearest signs of the project's ambition. Available project and engineering documentation does not describe the arena as a simple large hall equipped for occasional peak events. It presents it as a technically dense, high-performance venue designed to operate under very different conditions, from Olympic ice hockey to concerts and large-scale

entertainment. In this respect, system integration is not an accessory layer of the building. It is part of its market and functional logic.

Sources linked to Clivet stress the need to guarantee thermo-hygrometric control, high indoor air quality, and suitable acoustic and lighting performance across a facility with strong fluctuations in occupancy and use type. The same material highlights a site that includes almost 12,000 m² of external space and a multi-storey parking structure with around 2,750 spaces, partly conceived to allow possible future conversion to other uses. These details matter because they show that technical planning extended beyond the arena bowl itself and addressed circulation, serviceability and the broader operational ecosystem of the venue.

The most relevant aspect, however, concerns the environmental and mechanical systems. The available documentation refers to a large photovoltaic roof, optimised chillers, heat pumps, VRF systems, heat recovery, LED lighting and forms of adaptive energy control. The building targets LEED-oriented performance and that its technical design includes dedicated solutions for the management of high spectator loads and for the specific requirements of ice hockey. The combination of these systems suggests that the arena was conceived to handle both energy-intensive sporting configurations and more diversified post-event operating conditions without relying on a single rigid plant logic.

Another relevant point concerns peak-demand management. The technical reading emerging from the project material indicates that the arena was designed for up to 16,000 spectators and includes dedicated HVAC and dehumidification solutions specifically suited to hockey events and major-event conditions. This is not a minor technical refinement. In large indoor venues, the ability to maintain environmental control, comfort and operational continuity under peak loads is one of the clearest markers of real performance. It also affects the venue's capacity to function credibly in the post-event market, where reliability becomes part of competitiveness.

4.7. Sustainability measures and low-carbon construction

The sustainability profile of Unipol Dome is documented through more than generic design rhetoric. Arup states that the project set a maximum embodied-carbon target, privileged modular and off-site components, encouraged the use of reused and recycled materials, and incorporated natural or regenerative materials for internal finishes such as acoustic insulation. David Chipperfield Architects similarly refers to

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measures intended to reduce resource consumption and CO₂ emissions, while the rooftop photovoltaic system is described as capable of covering a substantial share of the building's energy needs.

These declarations are reinforced by specific material data. Holcim Italia reports the supply of more than 40,000 cubic metres of concrete for the project, including approximately 3,500 cubic metres of ECOPact low-CO₂ concrete used for the foundation piles. The same source notes the use of CAM-compliant ECOPact mixes for works associated with the upgrading of the Mecenate road system. An earlier Holcim note connected the use of self-compacting lower-carbon concrete to the foundation phase of the arena and explicitly framed the project within a broader urban regeneration strategy. Those details are useful because they move the sustainability discourse toward traceable decisions rather than general aspiration.

The arena's environmental strategy also includes rooftop photovoltaics, heat pumps, heat-recovery systems, LED lighting and adaptive energy control. Taken together, these measures suggest that part of the building's future operational profile was already anticipated in the design and construction phases. This is where the environmental dimension becomes most interesting. It is not presented simply as a matter of better construction practice. It is tied to the possibility of lower operating intensity, improved efficiency and greater resilience over time.

That said, the real meaning of these measures remains conditional. Their value for legacy will depend not only on reduced embodied impact at completion, but on whether they later contribute to a more efficient operational phase under real use conditions. A technically advanced low-carbon arena that remains underused would still present an ambiguous sustainability outcome. Tang et al. (2024) are useful here because they insist that environmental sustainability in Olympic venues cannot be detached from long-term utilisation. The same warning applies in the Santa Giulia case.

4.8. Unipol Dome within the wider Milano Santa Giulia regeneration project

The long-term success of the arena cannot be understood independently of the district in which it is located. Lendlease describes Milano Santa Giulia as a 110-hectare mixed-use development expected to include around 3,400 homes, together with office space, commercial functions, leisure uses and other facilities of metropolitan relevance, with a completion horizon extending approximately to 2034. The same material frames the

district as a zero-carbon-oriented development and as the first urban area in Italy registered under the LEED Neighbourhood Development Protocol, with an intended 50% reduction in project carbon budget compared with comparable developments.

The district vision presented through Milano Santa Giulia project materials reinforces this interpretation. The area is described as a connected, mixed and sustainable urban system designed by Mario Cucinella around a leaf-inspired organisational concept, with internal mobility networks, pedestrian and cycling routes, and strong intermodal accessibility through Milano Rogoredo, a major transport hub linking metro, suburban rail, regional services and high-speed rail. For the arena, this setting is not secondary. It is one of the conditions through which post-event relevance may later consolidate.

If Santa Giulia evolves into a dense and genuinely active urban district, the arena may benefit from stronger everyday accessibility, complementary services, broader territorial activation and a more favourable metropolitan ecosystem. If, by contrast, the district remains only partially completed or weakly consolidated, the venue will be more exposed to the risk of operating as an episodic destination detached from ordinary urban life. The difference is substantial. An arena rarely generates a robust long-term legacy as an isolated object. Its prospects improve when it becomes part of a larger and continuously active urban field. Chen (2015) supports this broader argument by linking venue legacy to territorial and urban conditions rather than to the building alone.

The relationship between district performance and venue performance is therefore unusually important in this case. Unipol Dome is not simply placed in a redevelopment zone. Its future depends, in part, on how that zone matures.

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Image 4.3 - Masterplan of the Milano Santa Giulia redevelopment area and location of Unipol Dome.
Source: The plan

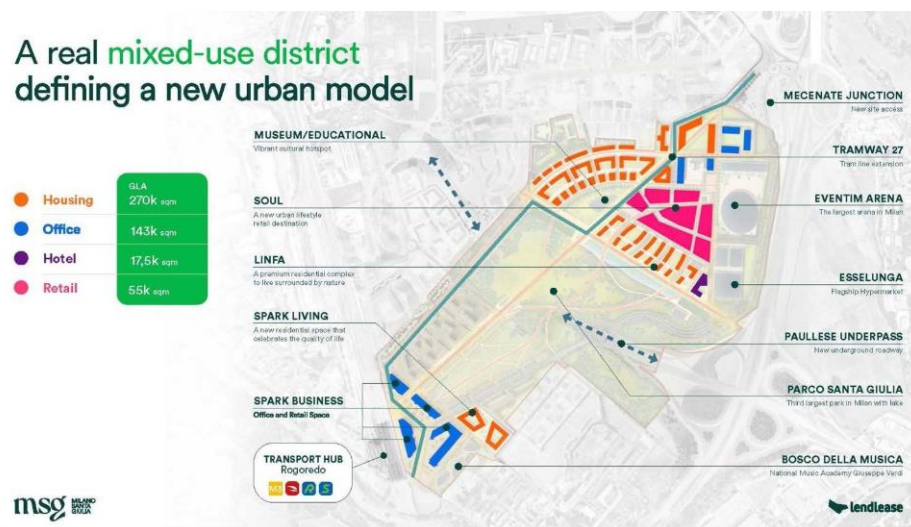


Image 4.4 - Mixed-use development strategy of the Milano Santa Giulia district surrounding Unipol Dome. Source: The Plan

4.9. Assessment of strengths and critical issues

The case presents several clear strengths. The multifunctional ambition is credible. The ownership and operator structure are more robust than in many Olympic venue cases. The technological profile is advanced. The environmental strategy is more concrete than rhetorical. The metropolitan location is favourable, and the connection with the

wider Santa Giulia redevelopment gives the arena access to a territorial logic that may later support stronger long-term relevance. These are not marginal advantages. They place the project in a better initial position than many of the Olympic venues that later turned into white elephants.

The critical issues, however, are just as real. The size and technical density of the arena imply a demanding operating threshold. This is not a modest venue that can easily survive on a thin calendar. It requires repeated and diversified activation. Its post-event logic is therefore dependent on market continuity, not simply on design quality. A second area of uncertainty concerns the district itself. The arena benefits from being embedded in a broader urban transformation, but that also means that its long-term integration depends partly on the pace and completeness of a process that extends beyond the venue. A third issue concerns the in-use phase more generally: much of the project's promised strength remains prospective because the arena has not yet accumulated a long enough record of ordinary post-event operation.

This leads to a more measured judgement. Unipol Dome should not be described as a resolved success, nor as a venue already exposed to failure. It occupies a more demanding middle ground. The project enters the post-Olympic horizon with several favourable structural conditions already visible in design, ownership logic, technological ambition and territorial positioning. Yet the variables that will truly determine its long-term legacy-use intensity, diversification, operating balance and effective district embedding-still belong to the phase that is only beginning to unfold.

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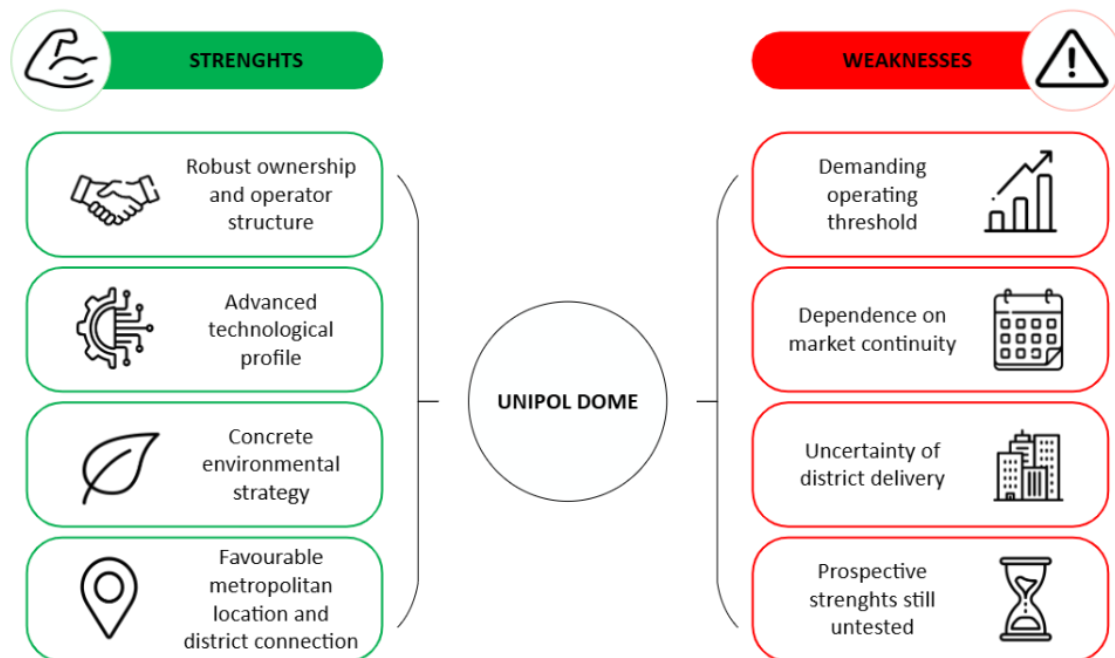


Figure 4.1 - Strengths and weaknesses framework for the assessment of Unipol Dome. Source: author's elaboration.

5. Comparative benchmarks: post-Olympic success stories

5.1. Role of benchmark analysis within the research

The benchmark analysis is not included in this thesis as a secondary comparative excursus, nor as a simple collection of successful Olympic stories. Its purpose is more exacting. The two selected cases are used to observe, under concrete post-event conditions, whether the factors discussed in the previous chapters actually support long-term viability once Olympic exceptionality has ended. This is the real threshold. A venue may perform efficiently during the Games and still prove weak afterwards; a more useful benchmark is one that remains active, absorbable and territorially meaningful once the event has disappeared from the foreground. In this sense, the comparative exercise supports the transition from theoretical discussion to evaluative reasoning, in line with the broader interpretation of legacy advanced by Chen (2015), Preuss and Plambeck (2021), Davis (2020), and Tang et al. (2024).

For this reason, Richmond Olympic Oval and London Aquatics Centre are not selected because they closely resemble Unipol Dome in formal or typological terms. They do not. Richmond was born as a speed skating oval for a Winter Olympics, while London Aquatics Centre is an aquatic venue developed for a Summer Olympics. Their value lies elsewhere. Both offer examples of positive post-Olympic legacy and, above all, help clarify how post-event sustainability can be supported through early planning, adaptive transformation and diversified long-term use. Their analytical relevance is therefore structural rather than mimetic. They illuminate conditions that may also matter for the Milanese case, even where the buildings themselves differ substantially. As the material already assembled in the thesis suggests, this is precisely why the benchmark method is useful here.

The comparative reading follows the same life-cycle logic adopted in the rest of the thesis. The benchmarks are examined through design, governance and institutional setting, transformation or legacy conversion, and current evidence of long-term use. This sequence is deliberate. Positive legacy is rarely the outcome of one isolated decision taken at the end of the process. It usually emerges when design assumptions, institutional arrangements and operating conditions remain aligned over time. The chapter therefore does not ask whether these venues were “successful” in a generic sense. It asks how that success was constructed, and through which concrete mechanisms. That is the part that matters for Unipol Dome.

A second reason for structuring the chapter in this way concerns the present condition of the Milanese arena itself. Arena Santa Giulia, now Unipol Dome, is still partly prospective as a long-term case. Its mature post-event record does not yet exist. The benchmark analysis partly compensates for this limit. It does not predict the future of the arena through direct analogy, and it would be methodologically weak to claim that it does. What it does provide is a more grounded basis for identifying recurring conditions that appear to support stronger long-term trajectories in Olympic venues.

5.2. Benchmark 1: Richmond Olympic Oval

5.2.1. Olympic origin and strategic role during the Vancouver 2010 Games

Richmond Olympic Oval was the official long-track speed skating venue for the Vancouver 2010 Winter Olympic Games and one of the most recognisable buildings of that edition. Its Olympic function was highly specialised, which is precisely what makes the case analytically valuable. Speed skating ovals are among the venue types most exposed to post-event fragility because their ordinary market is usually narrow. Richmond therefore deserves attention not because it avoided Olympic specialisation during the Games, but because it was conceived from the beginning with a life beyond them. Official Olympic material and the venue’s own institutional narrative both stress that the city of Richmond commissioned the building as more than a temporary Olympic shell, framing it instead as a civic asset capable of continuing to operate after Vancouver 2010 (IOC, n.d.; Richmond Olympic Oval, n.d.).

That early ambition is reinforced by project-related sources. CannonDesign presents the venue not only as a speed skating facility but also as a catalyst within the

redevelopment of the Richmond waterfront, while Leixner (2018) reads the building as part of a broader transformation strategy rather than as an isolated Olympic object. This distinction matters. Richmond did not become a positive legacy case because it later found an improvised second life. The post-event function had already been considered during the project phase. From the start, the venue was attached to a longer urban and civic narrative.



Image 5.1 - Exterior view of the Richmond Olympic Oval as a post-Olympic legacy venue. Source: ArchDaily.

This first feature already offers an important lesson for the present research. Positive legacy appears more plausible when the venue is not imagined as a self-contained Olympic object waiting for later rescue through conversion. Richmond suggests something more demanding: that post-event use should be integrated into the original concept of the building, even when the Games require a highly specialised temporary role.

5.2.2. Ownership, governance and institutional setting

The current institutional structure of Richmond Olympic Oval is one of the clearest reasons the case remains instructive. The venue is owned by the City of Richmond, while its operation is entrusted to the Richmond Olympic Oval Corporation, a municipal organisation created specifically to manage the facility and support its continued use through sport, fitness, health, wellness, community programming and events. The venue's own annual reporting presents this mandate explicitly, emphasising high-performance sport together with public-facing recreational and wellness functions, all supported by retail and commercial services (Richmond Olympic Oval, n.d.).

This governance arrangement should not be treated as a neutral administrative detail. It is one of the structural reasons the venue did not drift toward post-event irrelevance. Unlike privately driven entertainment venues oriented toward a narrow market logic, Richmond Olympic Oval operates through a public and multifunctional governance model in which success is measured not by one elite discipline but by diversified participation, continuous programming and civic value. In this sense, the building's long-term resilience appears tied less to Olympic prestige than to the existence of a stable operating subject capable of translating architectural flexibility into repeated use. Brar (2017), Kaplanidou and Karadakis (2010), and Kidd (2011) all support, in different ways, this broader interpretation of legacy as a social and institutional process rather than a merely physical outcome.

What emerges here is fairly clear. Buildings do not diversify themselves. Operators do. Richmond's post-event viability is linked not only to the venue's design, but to the existence of an institutional structure already oriented toward the long term. This point is especially relevant to Unipol Dome, where the relation between operator strength, programming continuity and post-event identity will be equally decisive.

5.2.3. Architectural and technical features

Architecturally and technically, Richmond Olympic Oval is a building of unusual ambition. CannonDesign reports a total floor area of approximately 512,000 square feet, while StructureCraft describes the main timber-roof project as covering roughly 260,000 square feet on a 6-acre site, completed in 2008. The discrepancy between the figures reflects different measurement scopes rather than contradiction, but both sources confirm the scale and technical intensity of the venue.

The most iconic element of the project is the timber wave roof. StructureCraft and CannonDesign describe it as an exceptional large-span wooden roof system, frequently presented as one of the most distinctive structural features of the venue. A further aspect strengthens its relevance: the timber was sourced from forests affected by mountain pine beetle infestation, turning what could have remained a purely structural choice into a material statement with ecological and economic significance (CannonDesign, n.d.; StructureCraft, n.d.).

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Image 5.2 - Architectural view of the Richmond Olympic Oval and its distinctive timber roof structure. Source: ArchDaily



Image 5.3 - Interior view of the Richmond Olympic Oval. Source: ArchDaily

This point should not be romanticised, but it deserves to be noticed. In many Olympic venues, strong architectural identity later becomes part of the problem when it is tied to over-specialisation or rigid use. Richmond appears to have taken a different path. Its architectural recognisability survived the Games without locking the building into a purely symbolic role. Leixner (2018) is useful here because the case shows how public recognisability can support rather than obstruct post-event relevance, provided it remains aligned with adaptive use.

The venue therefore offers a useful warning against simplistic assumptions. Architectural strength is not automatically a burden. It becomes one only when it is detached from long-term functionality.

5.2.4. Post-event transformation and adaptive reuse

One of the strongest reasons Richmond avoided the white elephant trajectory lies in the way the venue was transformed after the Games. The building did not remain a specialised speed skating facility waiting for occasional elite use. It was repositioned as a hybrid urban platform capable of combining high-performance sport, public recreation, health and wellness services, community activity, tourism linked to Olympic memory, and non-sporting events. Kaplanidou and Karadakis (2010) and Kidd (2011) are particularly useful in supporting this broader reading of long-term success.

This transformation is not interesting simply because it happened. What matters is the continuity between Olympic and post-event phases. Richmond suggests that delivery for the Games should not be judged only by punctual completion or by performance during competition weeks. It should be judged also by whether the venue enters the later phase with a credible adaptive pathway already embedded in its logic. The draft material assembled for this thesis makes precisely this point, drawing on CannonDesign and on Preuss and Plambeck (2021) to argue that Olympic and post-event phases should be treated as interconnected moments of one long process rather than as separate chapters (CannonDesign, n.d.)

For Unipol Dome, this is one of the most useful lessons of the Richmond case. A venue does not become resilient because transformation is theoretically possible. It becomes resilient when the transition from event-time configuration to ordinary operation has been anticipated early enough to remain institutionally and technically manageable.

5.2.5. Current uses and evidence of long-term viability

The present-day performance of Richmond Olympic Oval provides concrete evidence of durable legacy. According to the 2023 Annual Report, the venue recorded approximately 1.3 million visitations and hosted 57 events in 2023, alongside sports camps, community activity, health and wellness programmes, and high-performance training. These are not trivial figures. They suggest not occasional survival, but a stable pattern of broad and repeated use (Richmond Olympic Oval, n.d.).

This current use model is analytically persuasive because it is diversified. The venue is not dependent on one sport, one tenant or one nostalgic Olympic narrative. It functions through a broad ecosystem of activities. The IOC has repeatedly referred to Richmond as a positive legacy example, and Brar (2017) together with Leixner (2018) have also treated the venue as a successful case of post-event continuity. Institutional praise alone would not be enough to prove long-term sustainability, but when read alongside annual activity data and the current governance mandate, the case remains convincing. Richmond did not simply stay open. It became normalised within ordinary urban life.

This is a much higher threshold than symbolic survival. It is also the threshold against which a venue such as Unipol Dome will ultimately need to be read.

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Image 5.4 - Multifunctional post-Olympic use of the Richmond Olympic Oval. Source: Richmond Olympic Oval. (s.d.). Annual reports



Image 5.5 - Multifunctional post-Olympic use of the Richmond Olympic Oval. Source: Richmond Olympic Oval. (s.d.). Annual reports

5.2.6. Analytical implications for Unipol Dome

Richmond Olympic Oval offers three lessons that are directly relevant to Unipol Dome:

- The first concerns the design phase. Positive legacy is more likely when the initial concept of the venue is aligned with realistic post-event functions rather than suspended between Olympic peak use and generic later hopes.

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Richmond shows that even a highly specialised Olympic facility can remain viable if post-event use is considered early enough and treated as part of the original project logic. For Unipol Dome, this implies that declared multifunctionality will need to be tested against actual market compatibility rather than accepted as sufficient in itself.

- The second concerns the relation between delivery and later adaptation. Richmond demonstrates that the design phase should not aim only at delivering the building in time for the Games. It should also anticipate the subsequent phase of transformation and continuity of use. In other words, Olympic and post-event phases should be treated as interconnected moments of one continuous strategy. This is highly relevant for the Milanese arena, whose construction phase will need to be judged not only through time and cost, but also through the degree to which it supports future operational resilience.
- The third concerns use. Richmond's current functioning shows that long-term sustainability depends on diversified, continuous and measurable occupation. The venue remains active because it supports a wide range of community, wellness, event and high-performance uses, rather than relying on a narrow symbolic identity. For Unipol Dome, this is a particularly demanding lesson: long-term success cannot rest on architectural quality or Olympic origin alone. It must be supported by regular and socially embedded use over time.

Taken together, these elements make Richmond Olympic Oval a strong benchmark not because of strict typological similarity with Unipol Dome, but because it shows how legacy can be reinforced when design, governance and use remain aligned across time.

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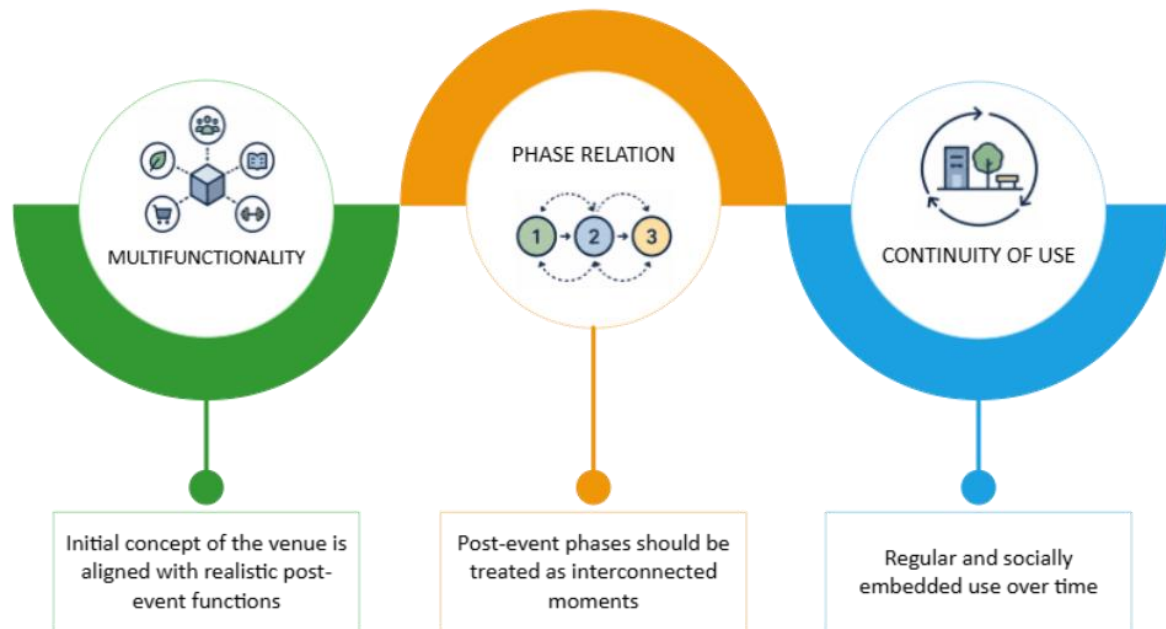


Figure 5.1 - Key benchmark-derived factors for post-Olympic venue legacy. Source: author's elaboration.

5.3. London Aquatic Center

5.3.1. Olympic origin and role within London 2012

London Aquatics Centre was one of the flagship purpose-built venues of the London 2012 Olympic and Paralympic Games. Located within what is now Queen Elizabeth Olympic Park, it hosted swimming, diving, synchronised swimming, Paralympic swimming, and the swimming segment of the modern pentathlon. Official venue history and King & Mungall (2012) states that the centre hosted 32 events across Olympic and Paralympic competition, which confirms its central role within the Games-time programme (London Aquatics Centre, n.d.).

The venue is relevant to this thesis because it was conceived not merely as an Olympic competition building, but as a permanent legacy facility and a major gateway structure for the wider Olympic Park. The centre's own historical account explains that the original brief already contained two distinct phases: first, a Games-time configuration

with temporary seating for 17,500 spectators; second, a post-Games conversion into a 2,500-seat venue for community, club, school and elite use, with the possibility of increasing capacity to 3,500 for major events. This detail is particularly important because it shows that legacy was embedded in the original design requirement rather than appended later as a corrective narrative as noted by Crockford et al. (2011) and Naish & Mason (2014).

The case therefore offers a different benchmark logic from Richmond. Where Richmond shows the value of early multifunctional anticipation, London shows the value of designing for two scales at once: the temporary exceptional scale of the Games and the more realistic scale of ordinary metropolitan use.

5.3.2. Design concept, technical configuration and adaptability

The London Aquatics Centre was designed by Zaha Hadid Architects, and official project descriptions present it as a building inspired by the fluid geometry of water in motion. Its wave-like roof became one of the most recognisable architectural images of London 2012. Zaha Hadid Architects describe the roof as an undulating form rising from the ground and enclosing the swimming and diving halls in one continuous gesture, while Thompson (2012) emphasises the building's formal singularity within the Olympic Park.

What makes the venue especially useful as a benchmark, however, is not only its architectural recognisability. It is the way architecture was linked to adaptability. Alongside the reduction of Games-time seating after 2012, the post-event venue retained three pools—two 50-metre swimming pools and one diving pool—together with diving platforms from 1 to 10 metres, a dry-diving area, fitness facilities and supporting services (King & Mungall, 2012). The centre now also includes a 100-station gym, fitness class spaces and a café. The mix is revealing. Olympic-standard aquatic infrastructure was preserved, but it was combined with community-oriented and everyday fitness functions that help stabilise use across a broader user base (Crockford et al., 2011; Naish & Mason, 2014).

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Image 5.6 - Exterior view of the London Aquatics Centre. Source: Archello.



Image 5.7 - Interior view of the London Aquatics Centre. Source: Archello.

London thus offers a strong example of how post-event viability may depend on a dual design logic. The venue remained architecturally distinctive, but it was not trapped by Olympic scale. That distinction is analytically useful for Unipol dome, where the problem will not be physical downsizing in the same literal sense, but the need to ensure that a large event venue also possesses a credible ordinary-use equilibrium.

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5.3.3. Governance, operation and institutional setting

The governance setting of London Aquatics Centre is inseparable from the wider legacy framework of Queen Elizabeth Olympic Park. The official park legacy corporation states that it was established in April 2012 specifically to use the “once-in-a-lifetime opportunity” of the Games to create a new heart for East London, supporting growth, opportunity and innovation. This broader context is significant because it shows that the Aquatics Centre was never intended to function as an isolated post-event facility. It was part of a district-scale legacy structure from the beginning (King & Mungall, 2012; Crockford et al., 2011).

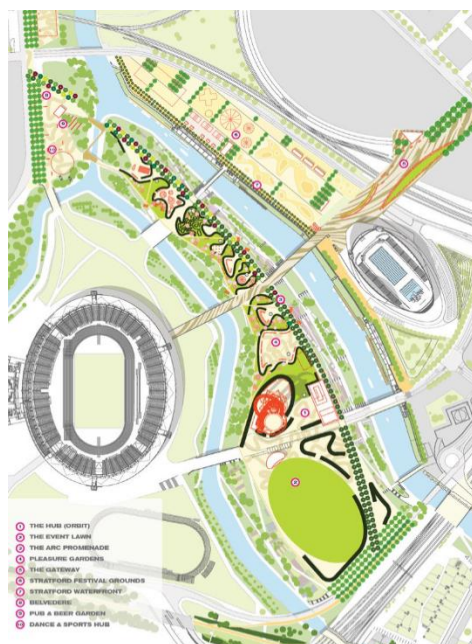


Image 5.8 - Post-Olympic transformation masterplan of Queen Elizabeth Olympic Park and the London Aquatics Centre context. Source: Designboom

At operational level, the venue is currently managed by Everyone Active. The venue history page and Queen Elizabeth Olympic Park materials indicate that Everyone Active secured management rights in 2023 and took over operational management in 2024, alongside further investment and agreements with elite aquatics partners (London Aquatics Centre, n.d.; Naish & Mason, 2014). This continuity under a specialist leisure operator is not a secondary matter. It links the venue to a viable day-to-day service model rather than to Olympic memory alone.

The governance lesson is therefore fairly direct. Long-term performance is strengthened when the venue remains institutionally embedded in a wider urban legacy framework while also being entrusted to an operator capable of handling everyday programming and public accessibility. This combination of district-scale governance and specialised operation is one of the strongest elements of the London case.

5.3.4. Post-event transformation and legacy conversion

The most analytically relevant feature of London Aquatics Centre is the way in which it was physically transformed after the Games. Official venue history states that, following London 2012, the centre underwent extensive alterations and reopened to the public in March 2014. The key transformation consisted in the removal of the temporary wings, reducing the venue from its Olympic capacity to a more realistic scale for ordinary community and elite use.

This point is more consequential than it may initially seem. The venue did not become successful because its full Olympic size happened, by luck, to fit long-term demand. It became viable because it had been designed from the outset to shed temporary capacity and move toward a different operational model. Naish and Mason (2014) together with Thompson (2012) support this reading clearly: long-term sustainability depends less on preserving the Games-time configuration than on planning a technically feasible and institutionally credible post-event mode.

The official legacy narrative reinforces the same interpretation by presenting the centre as a public facility that also hosts world-class events, international aquatics competitions, community activity and local employment. The venue's legacy is therefore expressed not only through architecture or symbolic value, but through continued accessibility, regular programming and measurable use (London Aquatics Centre, n.d.; King & Mungall, 2012).

5.3.5. Current use and evidence of long-term viability

The present-day performance of London Aquatics Centre provides one of the clearest empirical signs of durable legacy among post-Olympic venues. The venue history page states that it now welcomes more than one million visitors per year, while the official legacy page reports that since reopening in March 2014 it has welcomed over six million visitors. The current programme includes lane swimming, family sessions, lessons for children and adults, diving, fitness, community swimming and other

aquatic disciplines, while the centre also continues to host national and international events.

These figures are especially relevant because they indicate not occasional post-event prestige, but sustained and diversified use. The building remains active because it supports a broad and stable model of operation, one in which community accessibility and high-level sport coexist. That balance is difficult to achieve in aquatic venues, which often struggle under high operating costs and irregular demand. London appears to have avoided that trajectory precisely because it did not rely solely on elite events or Olympic symbolism.

5.3.6. Main legacy factors emerging from the London case

Three main legacy factors emerge from London Aquatics Centre:

- The first is scalable design. The coexistence of a temporary Games-time configuration and a smaller post-Games mode made it possible to reconcile Olympic visibility with later operational realism. Legacy was therefore not imagined as a vague aspiration. It was designed spatially and technically from the outset.
- The second is institutional embedding. The venue did not have to invent its legacy context after 2012. It was part of Queen Elizabeth Olympic Park and therefore inserted into a broader regeneration and governance structure that supported its continued relevance.
- The third is operational realism. The centre combines public accessibility with retained elite and event capacity. This gives the venue a broader use base than a narrow Olympic-afterglow strategy could ever provide. The lesson for Unipol Dome is not that all venues should physically downsize in the same way. It is that a venue built for Olympic peak use still needs a credible lower-intensity post-event equilibrium if it is to remain viable over time.

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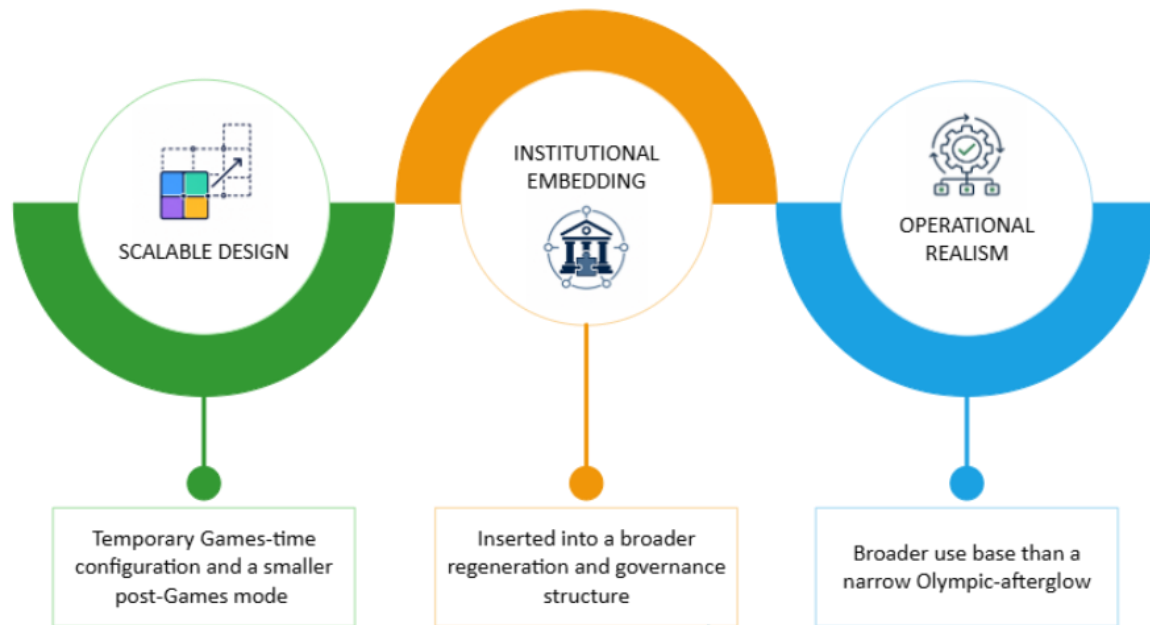


Figure 5.2 - Key benchmark-derived factors for post-Olympic venue legacy. Source: author's elaboration.

5.4. Comparative summary

The comparison between Richmond Olympic Oval and London Aquatics Centre shows that positive Olympic legacy does not derive from one isolated factor, nor from the symbolic prestige of the Games alone. In both cases, long-term success appears to result from the interaction of decisions and conditions distributed across the venue life cycle. This is why the comparison is particularly useful for the present thesis: it makes it possible to isolate a set of recurring conditions that may later inform the assessment of Unipol Dome (Preuss & Plambeck, 2021; Tang et al., 2024).

From the design-phase perspective, both cases demonstrate that legacy is more likely when post-event use is incorporated into the concept of the venue from the beginning. In Richmond, this took the form of a facility conceived as a multifunctional and community-oriented asset despite its specialised Olympic role. In London, it appeared through the coexistence of two configurations within the same design strategy: a temporary Olympic mode and a more realistic legacy mode. The architectural solutions differ. The principle does not. In both cases, long-term use was treated as a

primary requirement rather than as a later adjustment (Leixner, 2018; Crockford et al., 2011).

From the construction and transformation perspective, the two benchmarks show that delivery should not be judged only by whether the venue is completed in time for the Games. What proved decisive in both cases was the continuity between event-time readiness and post-event functionality. In Richmond, the Olympic phase and the long-term phase were aligned in the original development logic. In London, post-event transformation was planned and technically enabled from the start, allowing the venue to shift from Olympic intensity to ordinary operation without compromising viability. Construction and transformation therefore appear not as merely technical stages, but as strategic phases that condition long-term sustainability.

From the use-phase perspective, both cases indicate that long-term performance depends on continuity, diversity and realism of operation. Richmond is sustained by a wide ecosystem of activities, including community sport, fitness, wellness, high-performance programmes, events and Olympic-related attractions. London combines everyday public accessibility with elite and competitive aquatic use, thereby maintaining relevance without relying exclusively on exceptional events. In both cases, the venue remains active because it supports a broad and stable use model rather than a narrow or symbolic post-event identity.

Taken together, the two benchmark cases suggest that the long-term sustainability of an Olympic venue depends on at least three interrelated conditions. The first is the capacity of the design phase to anticipate post-event use through flexibility, adaptability and realistic future functions. The second is the ability of the construction or transformation phase to support the transition from Olympic use to ordinary operation without structural discontinuity. The third is the establishment of a use model based on diversified activities, frequent occupation and a clear relationship with the wider urban context (Chen, 2015; Preuss & Plambeck, 2021).

These conclusions are especially relevant for Unipol Dome. The Milanese arena does not need to imitate Richmond or London formally. It does, however, need to satisfy the same deeper condition that both benchmarks make visible: the alignment between post-event demand, governance capacity, design adaptability and a stable long-term use model. That is the point at which the benchmark analysis becomes useful for the evaluative framework developed in the following chapter.

6. A life-cycle AHP framework for the long-term evaluation of Unipol Dome

6.1. From benchmark analysis to the development of the evaluation model

The previous chapters made one point increasingly difficult to ignore. The long-term sustainability of Unipol Dome cannot be assessed through a purely descriptive reading of the project, nor through a generic discussion of legacy. The arena has already been examined as a multifunctional Olympic venue, as part of a wider regeneration process, and as a case whose post-event profile remains partly open. The benchmark analysis then added a further layer. Richmond Olympic Oval and London Aquatics Centre showed that durable post-event performance does not depend on one isolated factor, but on the way several conditions remain aligned across time: design choices, delivery logic, adaptability, governance and later use. At that stage, a more explicit evaluative structure becomes necessary.

This is the reason for introducing a formal model in the present chapter. The aim is not to transform a complex venue into a mechanistic score, nor to suggest that the future of Unipol Dome can be predicted with exactness before a mature operational record exists. The aim is narrower and, for that reason, more useful. The model is intended to organise the principal dimensions affecting long-term performance, assign them differentiated relevance and translate the resulting hierarchy into a structured evaluation. The literature on life-cycle sustainability assessment and multi-criteria decision-making offers a suitable basis for this move. Hossaini et al. (2015) show, in the context of building evaluation, that sustainability problems characterised by several interacting dimensions are more convincingly handled through hierarchical models rather than through isolated indicators. A similar logic appears in Fiore et al. (2020), where AHP is used to support the evaluation of complex interventions in the built environment.

The model proposed here should therefore be read as an AHP-based evaluative framework. This wording matters. The chapter does not apply AHP in a rigidly orthodox way for ranking multiple fully observable alternatives. It uses the method to construct a hierarchical weighting system and then combines that structure with a

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performance scoring stage applied to Unipol Dome. The outcome is a framework that remains methodologically disciplined without losing the flexibility required by a case whose in-use phase is still partly prospective.

A second choice should also be clarified. The model is organised around the three phases already adopted in the thesis: design and planning, construction, and in-use operation. This is not simply a matter of coherence with the previous chapters. It reflects the underlying argument of the whole dissertation. The post-event trajectory of an Olympic venue is not produced only after the Games. It is prepared in the design phase, conditioned in the construction phase, and then tested in operation. The framework is built to keep these temporal relations visible instead of flattening them into a single end-state judgement.

For this reason, the move from benchmark analysis to model development is not a rupture in the thesis. It is a translation. The benchmark chapter clarified what kinds of conditions matter. The present chapter reorganises those conditions into a more operational form.

6.2. The Analytic Hierarchy Process (AHP) as a support for life-cycle evaluation

The Analytic Hierarchy Process, originally formulated by Saaty (1980), is especially useful when the object of evaluation is too layered to be captured by one variable alone. That is exactly the condition encountered in this thesis. The long-term sustainability of Unipol Dome depends on architectural flexibility, technical strategy, delivery conditions, cost exposure, governance coherence, operating intensity, event diversification, urban integration and several other factors that do not belong to the same analytical order. AHP becomes relevant because it allows those elements to be decomposed into a hierarchy rather than left in an undifferentiated list.

The method works by structuring the problem into levels. At the top stands the overall objective. Below it stand the criteria and sub-criteria that shape the evaluation. At lower levels stand the indicators through which the criteria can be interpreted. What makes the method especially persuasive is not only its hierarchical clarity, but its use of pairwise comparison. Elements belonging to the same level are compared two at a time in relation to the level above. This comparison is typically carried out through Saaty's 1–9 fundamental scale, where 1 indicates equal importance and 9 indicates extreme importance of one element over another (Saaty, 1980).

This feature is more consequential than it may appear. In many evaluation exercises, weights are assigned directly, often in ways that remain opaque. AHP does something more disciplined. It forces the evaluator to state priorities through repeated bilateral comparisons, thereby making the weighting logic explicit. Tavana et al. (2023), in their broader reflection on the evolution of AHP, emphasise precisely this point: the method has remained influential not only because it is easy to operationalise, but because it translates complex judgement into a more transparent analytical sequence.

A second strength of AHP lies in its treatment of consistency. Human judgement is not assumed to be flawless. The method explicitly acknowledges the possibility of inconsistency and introduces a formal control through the Consistency Index (CI) and the Consistency Ratio (CR). Pant et al. (2022), in their review of consistency indices in AHP, show why this remains one of the central methodological features of the approach. The value of the weighting process depends not merely on having a matrix, but on having a matrix that is coherent enough to support interpretation.

The use of AHP in this thesis remains faithful to this core logic, though not in a completely classical sense. The method is used here primarily to derive the weighting structure of the model. The subsequent assessment of Unipol Dome is then carried out through a 1–5 performance scoring system. The distinction between these two operations should remain clear. The 1–9 scale belongs to the pairwise comparison phase and is used to derive weights. The 1–5 scale belongs to the application phase and is used to express the performance of the arena against each indicator. Keeping the two stages separate improves clarity and makes the framework easier to interpret.

This hybrid structure also has a methodological advantage. It preserves the hierarchical rigour of AHP while allowing the application phase to remain adaptable to a case that has not yet accumulated a fully mature post-event record. The method does not remove uncertainty. It gives it a form.

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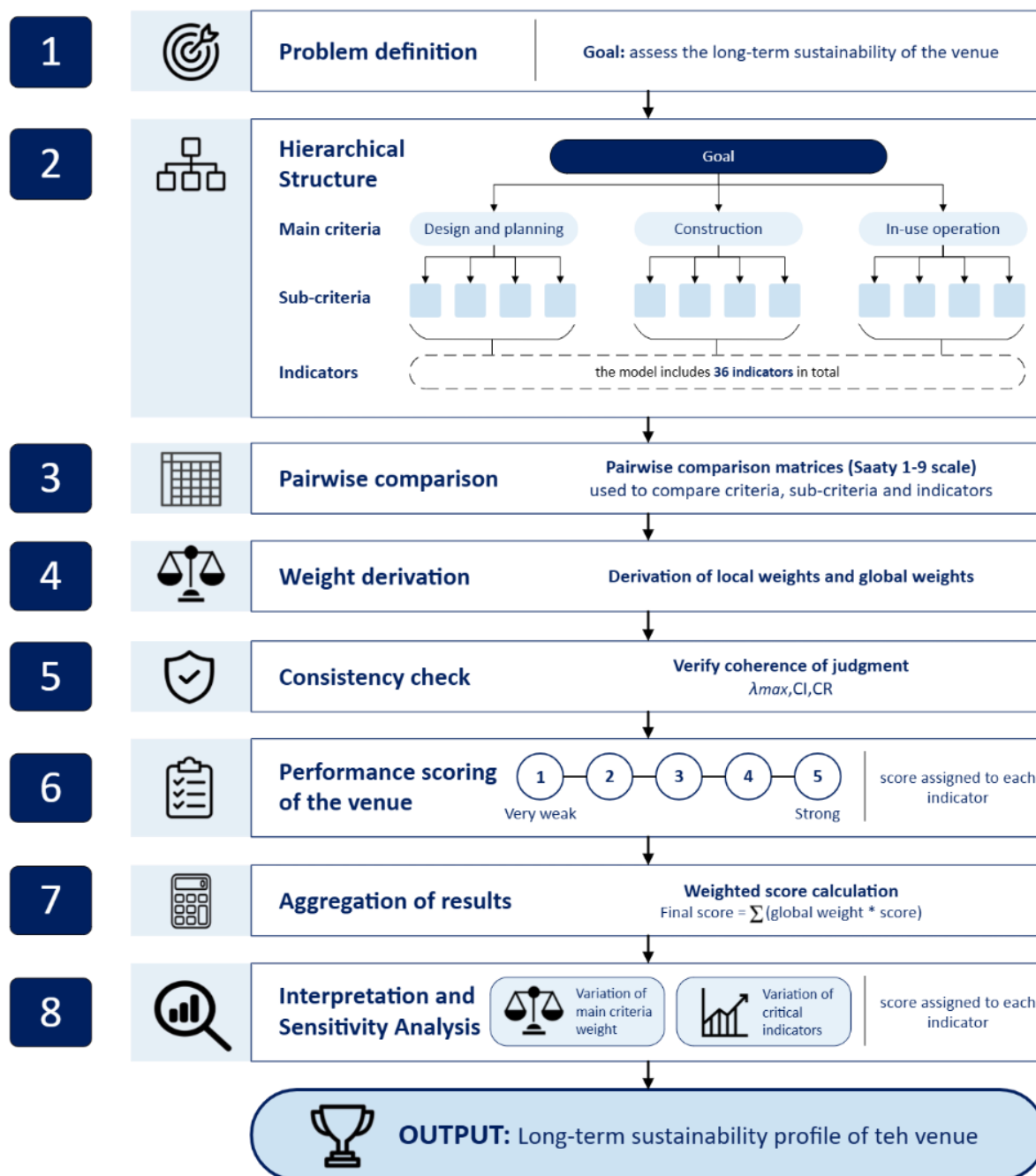


Figure 6.1 – Methodological workflow of the AHP-based life-cycle assessment framework for Olympic venue sustainability. Source: author's elaboration.

6.3. Main criteria and sub-criteria of the life-cycle evaluation framework

The selection of criteria and sub-criteria does not derive from an abstract or purely intuitive classification. It results from the convergence of two more precise needs. The first is the need to remain coherent with the life-cycle structure adopted throughout the thesis. The second is the need to translate that structure into a hierarchy that can actually support evaluation. Hossaini et al. (2015) are especially relevant here because their AHP-based life-cycle sustainability framework shows how a multi-phase building evaluation can be structured without losing analytical specificity. Fiore et al. (2020) are also useful in this respect, since their methodology demonstrates that hierarchical modelling becomes stronger when criteria are not merely listed, but organised according to a clear evaluative rationale.

The full structure of the AHP hierarchy, including the organisation of the main criteria and the related sub-criteria across the three life-cycle phases, is reported in ANNEX A. This annex provides the methodological basis for the framework used in the following sections.

6.3.1. Main criteria

At the highest level, the framework is built around three main criteria:

- C1 Design and planning phase
- C2 Construction phase
- C3 In-use phase

This tripartite structure reflects the argument already developed in the earlier chapters. A venue does not become sustainable or unsustainable at one single moment. Its long-term profile is shaped progressively. Design may favour or compromise future adaptability. Construction may reinforce or weaken future resilience. In-use operation finally reveals whether the arena can support a stable and absorbable post-event role.

The three criteria are not given equal conceptual meaning, even though all are necessary. The design phase is included because many decisive conditions are established there: capacity logic, multifunctionality, technical systems, governance configuration and legacy orientation. The construction phase is included because Olympic delivery pressure, procurement robustness,

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environmental execution and risk control are not temporary side issues; they leave traces that can affect long-term performance. The in-use phase is included because it is the moment in which the venue's real trajectory becomes visible through use continuity, operational burden, technical behaviour and urban integration.

6.3.2. Design-phase sub-criteria

The design and planning phase is articulated into four sub-criteria:

- C1.1 Functional and spatial strategy
- C1.2 Technical and energy strategy
- C1.3 Financial and governance setting
- C1.4 Urban integration and legacy orientation

The first sub-criterion concerns the relationship between the arena's spatial concept and its post-event role. It includes adaptability, configuration flexibility and the extent to which capacity and layout remain compatible with future demand rather than only with Olympic peak use. The second concerns the technical profile of the building as anticipated in the design stage, especially with regard to energy systems, plant integration and future operational control. The third recognises that design quality is not enough if the ownership and governance structure remain unstable or poorly aligned with long-term operation. The fourth addresses whether the venue is conceived as an isolated event object or as part of a wider urban and legacy strategy.

These sub-criteria are grouped in this way because they capture the most decisive design-phase questions for a venue of this type. They are not intended to cover every possible project feature. They are intended to isolate the ones that are most likely to affect later performance.

6.3.3. Construction-phase sub-criteria

The construction phase is also divided into four sub-criteria:

- C2.1 Delivery and schedule control
- C2.2 Cost and procurement robustness
- C2.3 Environmental performance in construction
- C2.4 Construction quality and risk control

This group reflects the fact that construction is not a neutral technical interval between design and use. Olympic delivery conditions are unusually compressed. The issue is therefore not only whether the venue is completed, but how it is completed. Delivery under schedule pressure, procurement resilience, cost stability, environmental execution and quality control all influence the long-term profile of the building.

The construction-phase structure is especially important in a case such as Unipol Dome because Olympic timing tends to magnify implementation pressure. A venue may appear strong in design terms and still enter operation in a more exposed condition if delivery has been excessively strained. The framework therefore treats the construction phase as a substantive part of long-term sustainability rather than as a temporary project-management concern.

6.3.4. In-use phase sub-criteria

The in-use phase is structured into four sub-criteria:

- C3.1 Functional intensity and diversification
- C3.2 Operational and economic sustainability
- C3.3 Energy and environmental performance in operation
- C3.4 Urban, social and legacy performance

The first sub-criterion concerns continuity of use: annual activity, regularity of occupation and diversity of event types. The second focuses on the relation between use and burden: revenue diversification, cost absorbability and operating balance. The third addresses how the technical and environmental ambition of the arena translates into real operational behaviour. The fourth widens the perspective and asks whether the venue is becoming territorially embedded and socially meaningful, or whether it remains exposed to under-consolidation.

This structure is selective by design. It does not attempt to describe every dimension of operation. It concentrates on those that are most closely related to the long-term viability of an Olympic arena once the event itself is over.

6.4. Indicators across the three life-cycle phases

The indicators were not chosen simply to maximise descriptive coverage. They were selected to translate the most analytically relevant conditions of long-term venue

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performance into an operational framework applicable to Unipol Dome. This step is one of the most delicate in the whole model. A criterion may appear well defined in conceptual terms and still remain too broad for practical evaluation unless it is linked to more specific observable conditions. Hossaini et al. (2015) are particularly useful here because they show how a life-cycle evaluation framework gains clarity when each phase is translated into structured indicators rather than left at the level of general principles. Fiore et al. (2020) reinforce the same point by demonstrating that the value of an AHP-based framework depends heavily on the internal coherence between hierarchical levels.

6.4.1. Design-phase indicators

The twelve indicators of these main criteria are divided based on the four sub-criteria described above. Together, these four blocks describe the extent to which the arena was conceived not as a short-term Olympic container, but as a venue capable of supporting an intelligible and durable post-event trajectory.

6.4.1.1. Functional and spatial strategy

The first indicator in this group is post-event functional adaptability. It measures the extent to which the venue can host multiple uses after the Games without requiring major structural intervention. The indicator is meant to assess whether the building can actually absorb concerts, sports events, entertainment formats and corporate uses within the same spatial logic, rather than through costly or exceptional reconfiguration.

The second indicator is capacity adequacy for long-term demand. Its role is narrower but no less delicate. It concerns the coherence between the scale of the venue and the expected ordinary demand once the exceptional Olympic phase is over. This is a classic legacy issue. Oversizing is one of the most recurrent mechanisms through which major-event venues become vulnerable in the medium term. For that reason, the indicator does not ask whether the arena is large. It asks whether its size is plausible in relation to the long-term metropolitan market in which it will operate.

The third indicator is spatial flexibility of layout. Its concern is internal. It evaluates whether the arrangement of the bowl, the seating systems and the support spaces allows different event configurations without excessive operational friction. What matters here is the practical elasticity of the plan. The venue should not only be adaptable in theory; it should also be able to host different formats through a layout that facilitates, rather than complicates, changeover and use diversification.

6.4.1.2. Technical and energy strategy

The second design sub-criterion addresses the technical basis of long-term performance. The first indicator here is integration of renewable energy systems. The point is not simply whether some renewable component is present, but whether renewable generation is embedded in the project in a way that has tangible relevance for the building's future operation.

The next indicator is energy-conscious plant concept. It concerns the extent to which HVAC systems, lighting, control logic and other technical systems were designed with energy performance in mind from the start. In an indoor arena, this aspect cannot be treated as secondary. Venues of this type are intrinsically energy-intensive, and the technical concept adopted in design has long-term implications for operating costs, environmental burden and resilience under variable conditions of use.

The third indicator in this block is design for operational efficiency and maintainability. Its role is slightly different. It concerns whether systems and spaces have been conceived in a way that facilitates maintenance, inspection, replacement and day-to-day operation. Buildings that are technically sophisticated yet difficult to maintain tend to become progressively more expensive and less resilient.

6.4.1.3. Financial and governance setting

The third design sub-criterion shifts attention away from the physical object and towards the structure that makes the venue operable as a project. The first indicator is clarity of ownership and governance model. It measures the degree to which ownership, operator identity and governance responsibilities are clearly structured. Ambiguity in governance can translate into weak strategic direction, blurred responsibilities and operational fragility later on.

The second indicator is consistency of investment structure. Its purpose is to assess the coherence and robustness of the public-private investment framework behind the arena. In the case of a venue such as Unipol Dome, this is particularly relevant because the project sits at the intersection of private initiative, Olympic function and urban transformation. The indicator does not simply ask whether funding exists. It asks whether the financial logic of the project is legible, stable enough and aligned with the long-term profile expected from the venue.

The third indicator is alignment between Olympic function and long-term business model. The issue is whether the venue's role during the Games is coherent

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with the economic and operational logic expected after the Games. Many post-event failures begin here. A venue is often tailored to the event in a way that later proves difficult to reconcile with ordinary demand.

6.4.1.4. Urban integration and legacy by design

The fourth design sub-criterion addresses the relation between the venue and its territorial setting. The first indicator is accessibility and multimodal connectivity by design. This refers to the quality of planned access through metro, rail, road systems, pedestrian routes and cycling infrastructure. The indicator is not limited to the existence of access modes. It asks whether the venue is positioned within a mobility system capable of supporting repeated and diversified use after the event.

The second indicator is integration with surrounding district functions. It measures the extent to which the venue is embedded in a mixed-use urban context rather than operating as an isolated enclave. The presence of housing, leisure, retail, services and complementary urban functions matters because it affects the intensity, rhythm and regularity with which the venue can become part of ordinary city life. In legacy terms, this is a major distinction. A venue placed in a district that remains weakly activated after the event faces a more difficult path, even if the building itself is well designed.

The third indicator is explicit consideration of post-event legacy in planning. Here the issue is not whether legacy can later be claimed, but whether it is already visible in the rationale of the project. The indicator therefore examines whether long-term use is clearly stated, structured and present in the planning logic rather than left as an implicit hope. It presupposes that post-event function is recognizable as an active design driver.

6.4.2. Construction-phase criteria and indicators

The construction phase is again divided into four sub-criteria: delivery and schedule control, cost and procurement robustness, environmental performance in construction, and construction quality and risk control. These blocks were selected because the way a venue is delivered has direct implications for its future stability. In Olympic projects, delivery is never a neutral technical interval between design and use. It is a period marked by deadline pressure, contractual complexity, public scrutiny and possible trade-offs between speed, cost and quality. Those trade-offs can leave traces that persist well beyond completion.

6.4.2.1. Delivery and schedule control

The first indicator is compliance with Olympic delivery timeline. It evaluates the degree to which the project respected the fixed event deadline. This is a straightforward but unavoidable indicator. Olympic venues are tied to non-negotiable dates, and slippage may generate cascading effects on testing, commissioning and early operation.

The second indicator is continuity and reliability of construction process. This is broader than compliance with deadline alone. It concerns the stability of the delivery process under pressure: whether the construction trajectory remained coherent, coordinated and relatively continuous rather than fragmented by repeated interruptions, restructuring or significant instability.

The third indicator is readiness for transition from construction to operation. It addresses the shift between physical completion and actual operability. A venue may be completed in formal terms and still remain weakly prepared for testing, handover or early use. This indicator therefore measures whether the transition into operational status occurs in an efficient and credible manner.

6.4.2.2. Cost and procurement robustness

The first indicator in this group is cost control during delivery. Its purpose is to assess the extent to which the evolution of costs remained understandable and reasonably contained. This does not mean that any budget change automatically implies poor performance. In large event-driven projects, some level of adjustment is almost expected. The indicator is concerned instead with whether deviations remain limited, legible and justifiable, or whether the cost trajectory becomes unstable and progressively detached from the original framework.

The second indicator is procurement and contractor coordination effectiveness. A venue can fail to maintain delivery quality not because the design is weak, but because the procurement and contractor structure does not support coherent execution. This indicator measures the quality of that coordination.

The third indicator is resilience to schedule-cost pressure. It examines the project's capacity to absorb Olympic deadline pressure and associated cost tension without major destabilization. In practice, it asks whether the project can remain viable under stress.

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6.4.2.3. Environmental performance in construction

The first indicator in this sub-criterion is use of low-carbon and lower-impact materials. It evaluates whether materials with reduced embodied impact were visibly adopted in the construction process. It is linked to the actual presence and relevance of material choices that reduce environmental burden, such as lower-carbon concrete or other construction components with lower impact profiles.

The second indicator is embodied carbon mitigation measures. This goes one step further. Rather than focusing only on materials, it measures whether the project includes an explicit strategy for reducing embodied carbon during the construction phase. The emphasis lies on the presence of recognizable and documented mitigation actions.

The third indicator is construction waste and logistics efficiency. Here the issue is the management of the site itself: waste reduction, material flows, logistics coordination and the control of construction-related inefficiencies. In practice, this indicator captures the quality of environmental management during delivery. It is less visible than design-level sustainability claims, but it often says more about the operational seriousness of the project.

6.4.2.4. Construction quality and risk control

The first indicator in this group is construction quality assurance. It refers to the presence of systems and procedures aimed at ensuring compliance with design and quality requirements during delivery.

The second indicator is risk management and compliance control. This concerns the degree of control over risk, safety, legality and formal compliance. In event-related public projects, this area is particularly sensitive because the implementation process is often exposed to strong visibility and institutional pressure.

The third indicator is consistency between planned and delivered performance. Its purpose is to assess whether the completed venue corresponds, in technical and functional terms, to what had been intended during planning. This indicator is especially important because delivery under pressure can produce distortions that are not always evident in the final architectural image.

6.4.3. In-use phase criteria and indicators

The in-use phase includes the following four sub-criteria: functional intensity and diversification, operational and economic sustainability, energy and environmental performance in operation, and urban, social and legacy performance. This is the part of the framework where the long-term character of the thesis emerges most clearly. The design and construction phases prepare the venue. Operation judges it.

6.4.3.1. Functional intensity and diversification

The first indicator is annual intensity of use. This measures the number of active event or use days per year. A large venue that remains active only occasionally is structurally exposed, even if its technical profile is strong.

The second indicator is diversity of hosted event types. Its role is to assess whether the venue can support a broad range of functions over the year rather than depending on one single event family. A high score is associated with genuine diversification -sport, entertainment, corporate functions, cultural events and other compatible formats- because diversification tends to increase resilience (there can be also exceptional case for which the use after the Olympic game is focused on only one activity and still prove positive legacy).

The third indicator is occupancy and utilisation regularity. This complements the previous two. A venue may host many events in concentrated periods and still remain fragile if the use pattern is irregular or excessively episodic. The indicator therefore measures the stability of use over time.

6.4.3.2. Operational and economic sustainability

The first indicator here is balance between operating burden and activity level. It concerns the relationship between what the venue costs to operate and the volume of activity it is capable of sustaining. This is one of the clearest long-term stress points for large indoor arenas.

The second indicator is revenue diversification potential. It evaluates the capacity of the arena to generate income from multiple sources rather than relying too heavily on one stream only. This is particularly relevant in post-event venues because dependence on a narrow revenue base tends to increase fragility.

The third indicator is maintenance and operational resilience. Its focus is the ability of the venue to sustain maintenance and day-to-day operations over time without progressive decline or unmanageable strain. The indicator captures the longer-term

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robustness of the operating model, especially in relation to technical complexity and recurring maintenance requirements.

6.4.3.3. Energy and environmental performance in operation

The first indicator is operational energy efficiency. It measures the extent to which energy demand can be controlled in ordinary operation. This is a necessary indicator in the case of an arena, since large indoor venues are inherently energy-intensive.

The second indicator is ability to manage peak demand during major events. Venues of this kind do not operate under stable loads. They experience substantial peaks associated with attendance, lighting, HVAC demand and event-specific configurations. This indicator therefore evaluates whether the technical systems can absorb these peaks without disproportionate inefficiency or performance degradation.

The third indicator is environmental performance under varying occupancy conditions. It refers to the adaptability of systems to different levels of use. This is not identical to peak management. It concerns whether the arena can move between sparse use, intermediate activity and major events without forcing the building into wasteful operational modes.

6.4.3.4. Urban, social and legacy performance

The first indicator in this final block is contribution to district activation. It measures the extent to which the venue can stimulate activity in the surrounding area, not just within its own envelope.

The second indicator is public and urban relevance beyond event days. This captures the broader civic and urban role of the venue once the Games are over. A building of this type may become visible without becoming meaningful. The indicator therefore asks whether the arena retains a recognisable role in urban life outside the short cycle of exceptional events.

The final indicator is risk of underuse / white elephant exposure. This is the indicator that closes the entire framework. It synthesises the long-term concern running through the thesis. A high score here does not mean a high risk; it means low exposure to that risk. The evaluation should therefore reflect the extent to which the venue appears protected from the trajectory that has affected many large event-driven infrastructures in the past.

6.5. Weighting structure and pairwise comparison

Once the hierarchy of criteria, sub-criteria and indicators had been defined, the next methodological step consisted in assigning them relative importance. This is where the AHP logic becomes central. Instead of attributing weights directly, the model uses pairwise comparison matrices in order to formalise the internal hierarchy of the framework. Saaty (1980) provides the classic basis for this operation, while Tavana et al. (2023) help situate the method within a more recent understanding of AHP as a still-evolving decision-support approach rather than as a closed historical technique. The purpose of this phase is not to claim that the weighting system is universally fixed. The purpose is to make the adopted hierarchy explicit, reasoned and internally coherent. This matters because the model includes criteria belonging to different phases and analytical orders. Without weighting, the framework would risk treating all variables as if they had equal influence. That would not reflect the actual logic of long-term venue performance.

The detailed pairwise comparison matrices used to derive the weights of the main criteria and of the phase sub-criteria are provided in ANNEX A. The annex makes explicit the comparison logic behind the weighting structure adopted in the model

6.5.1. Main criteria weights

At the highest level, the three main criteria-design and planning, construction, and in-use phase-were compared pairwise in relation to the overall objective of long-term sustainability.

	Design	Construction	In-use
Design	1.00	1.00	0.50
Construction	1.00	1.00	0.50
In-use	2.00	2.00	1.00

Table 6.1 - Pairwise comparison matrix of the main life-cycle criteria used in the AHP assessment framework. Source: author’s elaboration.

This matrix expresses a simple judgement pattern: design and construction are considered equally important; both are less important than the in-use phase. The step forward consist in normalize it to obtain the local weight.

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	Design and planning	Construction	In-use	<u>Local weight</u>
Design and planning	0,25	0,25	0,25	0,25
Construction	0,25	0,25	0,25	0,25
In-use	0,50	0,50	0,50	0,50

Table 6.2 - Normalized pairwise comparison matrix and local weights of the main life-cycle criteria. Source: author's elaboration.

The three main criteria were weighted as follows:

- Design and planning = 0.25
- Construction = 0.25
- In-use operation = 0.50

The resulting weighting structure attributes the greatest relevance to the in-use phase, followed by the design and planning phase and by the construction phase. This hierarchy is not arbitrary. It reflects the reasoning of the thesis. The in-use phase matters most because it is the phase in which the real trajectory of the arena becomes visible. The design phase remains relevant because many decisive conditions are seeded there. And also the construction phase is essential because delivery conditions affect later resilience.

6.5.2. Sub-criteria weights

The procedure done for the main criteria is then replicated for the sub-criteria of all three phases, based on the importance each of them has within the corresponding phase.

Phase	Sub-criterion	Weight
Design	Functional and spatial strategy	0.35
Design	Technical and energy strategy	0.30
Design	Financial and governance setting	0.15

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Design	Urban integration and legacy by design	0.20
Construction	Delivery and schedule control	0.30
Construction	Cost and procurement robustness	0.25
Construction	Environmental performance in construction	0.20
Construction	Construction quality and risk control	0.25
In-use	Functional intensity and diversification	0.30
In-use	Operational and economic sustainability	0.25
In-use	Energy and environmental performance in operation	0.20
In-use	Urban, social and legacy performance	0.25

Table 6.3 - Local weights assigned to the sub-criteria. Source: author’s elaboration.

The profile that emerges from these weights is worth noting. In design, the model privileges functional adaptability over governance structure. In construction, timing and delivery remain slightly more influential than environmental construction measures. In operation, intensity of use is weighted more heavily than the other in-use blocks. This reveals a clear orientation: legacy is judged first through the ability of the venue to remain used and absorbable, and only then through its symbolic or architectural position.

To conclude this part of the method, the procedure is repeated for the indicators divided according to the sub-criteria and the mark assigned is again the corresponsive of the importance given inside the group.

6.5.3. Local and global weights

Each indicator receives a local weight within its own sub-criterion. This local weight (w) is obtained by dividing the average value of each indicator for the sum of the average value of all the indicators related to the sub-criteria.

$$Local\ weight = AverageX / sum[average(X+Y+Z)]$$

That local weight is then transformed into a global weight by multiplying it by the weight of the corresponding phase and sub-criterion. The result is the actual contribution of the indicator to the final score.

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$$Global\ weight = w_{MainCriteria} * w_{SubCriteria} * w_{Indicator}$$

Indicator	Local weight	Global weight	Computation
I1 Post-event functional adaptability	0.45	0.039375	$0.25 \times 0.35 \times 0.45$
I2 Capacity adequacy for long-term demand	0.30	0.026250	$0.25 \times 0.35 \times 0.30$
I3 Spatial flexibility of layout	0.25	0.021875	$0.25 \times 0.35 \times 0.25$

Table 6.4 - Local and global weights of the functional and spatial strategy indicators within the design phase. Source: author's elaboration.

Although the distinction between local and global weight is technical, its implications are quite straightforward. An indicator may be highly relevant within its own sub-criterion and still have a limited effect on the overall result if that sub-criterion, or the phase to which it belongs, carries a lower weight in the hierarchy. By contrast, an indicator with a similar local importance may contribute more strongly to the final evaluation when it is placed within a more heavily weighted part of the model.

The complete indicator-level weighting structure, including local weights and global weights, is reported in ANNEX B. This additional material allows the reader to reconstruct how the relative importance of each indicator was translated into its contribution to the overall assessment.

6.6. Consistency of the pairwise matrices

The reliability of the weighting structure depends not only on the existence of pairwise comparisons, but also on their coherence. This is why the consistency test is an essential part of the model. Saaty (1980) introduced the logic of consistency control as one of the key safeguards of AHP, and Pant et al. (2022) confirm, from a more recent perspective, that consistency remains one of the defining strengths of the method. For each matrix, the principal eigenvalue was multiplied for the local weight (w), in order to then obtain λ_{max} , which was then used to derive the Consistency Index and Consistency Ratio.

To calrify:

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- Once we have the local weight we calculate $A*w$

$$A*w = \text{sum}[\text{principal eigenvalue} * w]$$

- At this point to check if the weights obtained are consistent with the comparison matrix, we calculate $Aw = \lambda_{max} w$ to obtain the value of λ_{max}
- We can proceed to verify the consistency index (CI)

$$CI = (\lambda_{max} * n) / (n-1)$$

n is the order of the matrix

- In order to calculate the consistency ratio we need the Random Index (RI). As established in the methodological literature, the value of RI depends on matrix size rather than on the substantive nature of the case study, and matrices are usually considered acceptable when ($CR < 0.10$) (Saaty, 1980; Saaty, 2008).

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

Table 6.5 - Random Index values used for the consistency assessment of AHP pairwise comparison matrices. Source: Saaty 1980

$$CR = CI / RI$$

In the present framework, all matrices returned:

- ($CI = 0$)
- ($CR = 0$)

Matrix family	Size	CI	CR
Main criteria	3×3	0.00	0.00
Sub-criteria matrices	4×4	0.00	0.00
Indicator matrices	3×3	0.00	0.00

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Table 6.6 - Consistency Index and Consistency Ratio values for the AHP matrix families used in the assessment framework. Source: author's elaboration.

The matrices used in the present framework remain within acceptable consistency limits. This does not imply perfect judgement. It implies that the weighting logic is coherent enough to support interpretation and application. The relevance of this point should not be understated. In a model such as this, internal coherence is what prevents the hierarchy from collapsing into an arbitrary list of preferences.

The consistency checks for the indicator-level matrices, together with the related local and global weights, are documented in ANNEX B. This annex supports the methodological transparency of the weighting process and shows that the pairwise comparisons remain within acceptable consistency limits.

6.6.1. Robustness and validation of the weighting structure

Although the consistency ratios of the pairwise comparison matrices remain within acceptable thresholds, consistency alone does not fully guarantee the robustness of the weighting structure. A further validation step is therefore required.

The weighting system adopted in this research was not derived from subjective judgement alone. The relative importance assigned to criteria and sub-criteria emerged through a triangulation process involving four complementary sources.

The first source is the academic literature on Olympic legacy, venue sustainability and infrastructure management. The recurring factors identified by previous studies provided the theoretical basis for defining the hierarchy of criteria.

The second source is represented by the comparative benchmark analysis developed in Chapter 5. The Richmond Olympic Oval and the London Aquatics Centre were not used merely as illustrative examples. Their post-event trajectories were examined in order to identify recurring determinants of long-term success, particularly with respect to adaptability, governance quality, operational continuity and integration within the surrounding urban context.

The third source consists of consultations with professionals operating in fields related to venue development, construction management, real estate, infrastructure delivery and facility operation. Their observations were used to verify the practical relevance of the proposed criteria and to support the calibration of relative priorities among the different dimensions of the framework. While these

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consultations do not constitute a formal Delphi process, they provided an important practitioner perspective capable of complementing the academic evidence.

The fourth source is the internal coherence of the life-cycle framework itself. Since the objective of the research is to evaluate long-term sustainability across the entire venue life cycle, weights were calibrated to reflect the relative influence of decisions made during the design, construction and operational phases on future performance.

The resulting weighting structure should therefore be interpreted as an analytically informed representation of relative importance rather than as an exact measurement of objective reality. For this reason, the framework incorporates a dedicated sensitivity analysis aimed at testing the stability of the final results under alternative weighting assumptions.

6.7. Performance scoring of Unipol Dome

The weighting structure is only the first layer of the framework. It establishes what matters and how much. A second operation is required to evaluate how Unipol Dome performs against each indicator. This is done through a 1-5 scoring scale. The choice of a 1-5 scale, rather than a second use of Saaty’s 1-9 logic, is intentional.

The two procedures serve different purposes. The 1-9 scale is suitable for pairwise comparison, where the issue is relative importance. The 1-5 scale is more appropriate when the issue is case-specific performance. That is the situation here.

Score	Interpretation
1	Very weak condition
2	Weak condition
3	Moderate condition
4	Good condition
5	Strong condition

Table 6.7 - Scoring scale used to assess the performance of Unipol Dome across the AHP indicators. Source: author’s elaboration.

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The score assigned to each indicator is based on the project evidence gathered in the previous chapters. Some indicators rely on relatively clear factual elements, such as plant strategy, ownership clarity or the presence of low-carbon materials. Others, particularly those in the in-use phase, are necessarily more interpretative because they concern a long-term operational behaviour that is not yet fully observable.

The weighted score of each indicator is calculated as:

$$WS_i = GW_i \times S_i$$

The final score of the arena is the sum of all weighted scores:

$$FS = \sum WS_i$$

This procedure makes the framework usable. The global weights ensure that the hierarchy is respected. The performance scores ensure that the hierarchy is applied to the actual case rather than remaining abstract.

The detailed application of the scoring system to Unipol Dome and to the selected benchmark venues is presented in ANNEX C. The annex reports the full evaluation tables and clarifies how the weighted indicators were translated into comparative performance profiles.

6.8. Application of the framework to Unipol Dome

6.8.1. Design and planning phase

Unipol Dome performs relatively well in the design and planning phase. The arena benefits from a credible multifunctional concept, a strong metropolitan position and a technical strategy that appears relatively advanced. Its ownership and operator structure also provide a more stable starting point than that found in many historically weak Olympic venues.

The more uncertain aspects concern the relationship between capacity and future ordinary demand, together with the extent to which the arena's strong design profile will actually translate into durable post-event compatibility. The design phase therefore appears favourable overall, though not without some open questions.

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6.8.2. Construction phase

The construction phase produces a more mixed profile. The project appears reasonably strong in relation to delivery completion, environmental measures and construction-stage quality logic. The presence of low-carbon material choices and sustainability-oriented construction strategies supports this reading.

The weaker side is concentrated in schedule-cost pressure and procurement exposure. This is not unexpected in an Olympic context. The key point is not that delivery pressure existed, but that it is acknowledged as part of the evaluative profile of the arena rather than treated as a temporary inconvenience.

6.8.3. In-use phase

The in-use phase is the most exposed and, at the same time, the most decisive. Unipol Dome performs relatively well in relation to event diversification potential and, to a more limited degree, revenue diversification potential. These strengths are consistent with the arena’s multifunctional and metropolitan logic.

The more uncertain indicators are annual intensity of use, regularity of occupancy, operational balance, district activation and white-elephant exposure. The moderate scores assigned here do not imply failure. They reflect an open condition. The arena has the potential to become a strong long-term asset, but this depends on whether future operation confirms rather than contradicts the promise embedded in the design phase.

Phase	Weighted subtotal	Share of total
Design and planning	0.972	27.87%
Construction	0.915	26.24%
In-use operation	1.601	45.89%
Total	3.489 / 5	100%

Table 6.8 - Weighted performance results of Unipol Dome across the three life-cycle phases of the AHP assessment framework. Source: author’s elaboration.

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Metric	Value
Total weighted score	3.4569 / 5
Normalised score	69.1%
Assessment class	Moderate-to-positive sustainability with manageable risks

Table 6.9 - Overall AHP assessment result and sustainability classification of Unipol Dome. Source: author’s elaboration

A more detailed breakdown of the evaluation across the three life-cycle phases is included in ANNEX C. This annex should be read as the technical support to the interpretation presented here, since it reports the scores assigned to Unipol Dome and compares them with the benchmark cases.

6.9. Interpretation of the result

The final result does not support an overly celebratory reading. It also does not justify a negative one. Unipol Dome emerges as a venue with a moderately positive but still exposed profile.

This is, in methodological terms, a credible outcome. A strongly positive result would be difficult to defend given that the arena has not yet completed a mature post-event trajectory. A weak result would flatten the actual strengths of the project. The framework instead returns a more nuanced profile: favourable initial conditions are clearly present, especially in design and strategic positioning, but the in-use phase remains the real test.

The result therefore suggests a specific interpretation. Unipol Dome is not yet a confirmed success story. It is a venue with a plausible pathway toward long-term success, provided that its future use becomes dense enough, varied enough and balanced enough to support the scale and technical ambition of the asset.

6.10. Sensitivity analysis

6.10.1. Purpose of the sensitivity analysis

The purpose of the sensitivity analysis is not to replace the main result, but to verify whether the evaluative profile remains broadly stable when plausible changes are

introduced into the weighting structure of the model. In AHP-based frameworks, this step is particularly useful because a coherent result should not depend excessively on one fragile weighting assumption. Librantz et al.(2016) show, in a different application domain, why the combination of AHP modelling and sensitivity analysis is useful precisely for testing the robustness of the final ranking or assessment.

In the present thesis, the sensitivity analysis is especially relevant because some in-use indicators remain partly prospective. Robustness therefore becomes a substantive methodological issue rather than a merely technical appendix.

Two sets of tests were carried out:

- 1. variation of the main criteria weights
- 2. variation of selected critical indicators

The first examines the robustness of the framework structure. The second is more substantive. It tests the impact of changes in the variables that are most likely to shape the long-term trajectory of the arena.

The complete sensitivity analysis tables are reported in ANNEX D. They show how the overall result changes under alternative weighting scenarios and under variations of selected critical indicators.

6.10.2. Variation of main criteria weights

The first test altered the relative weights of design, construction and in-use while leaving the indicator scores unchanged.

Scenario	Final score	Assessment
Base case	3.49	Moderate-to-positive
Balanced phases	3.58	Moderate-to-positive
Design-led	3.53	Moderate-to-positive
Construction-risk	3.53	Moderate-to-positive
Use-intensive	3.43	Moderate-to-positive

Table 6.10 - Sensitivity analysis results of the AHP assessment under alternative weighting scenarios. Source: author’s elaboration.

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The outcome is fairly stable. The range of variation is limited, and the interpretative class does not change. This suggests that the model is not excessively sensitive to moderate rebalancing of the three life-cycle phases. The hierarchy matters, but the final result is not artificially driven by a fragile weighting choice.

6.10.3. Variation of selected critical indicators

The second test focuses on a narrower set of indicators whose influence on the post-event trajectory is likely to be stronger. These include annual intensity of use, event diversification, operational burden, district activation and white elephant exposure.

<i>Scenario</i>	<i>Final score</i>	<i>Assessment</i>
Base case	3.49	Moderate-to-positive
Demand underperformance	3.15	Moderate
Urban integration delay	3.36	Moderate
Operational stress	3.34	Moderate
Favourable consolidation	3.93	Moderate-to-positive

Table 6.11 - Sensitivity analysis results of the AHP assessment under alternative weighting indicators. Source: author's elaboration.

These variations produce a more visible shift. The change is not chaotic, but it is substantial enough to show where the model's real exposure lies. The arena's final profile is much more responsive to changes in operational and legacy-related indicators than to modest changes in the weighting structure.

6.10.4. Discussion of robustness

The sensitivity analysis makes it possible to interpret the final result with greater precision. The first aspect that emerges quite clearly is that the model does not react in the same way to all kinds of variation. When the test is limited to a moderate redistribution of the weights assigned to the three main phases of the life cycle, the

final score remains relatively stable. Across the scenarios considered, the weighted score varies within a narrow interval, from 3.43 to 3.58, around a base-case value of 3.49. The resulting range, equal to 0.15, suggests a low degree of sensitivity to this type of modification. In practical terms, this means that the overall assessment of Unipol Dome is not excessively dependent on the exact balance assigned to design, construction and in-use operation. The model therefore appears structurally robust at the macro level.

This result is analytically relevant because it shows that the final judgement does not derive from an arbitrary weighting configuration. The moderate-to-good profile of the arena is preserved even when greater relative importance is assigned to design, to construction, or to the in-use phase.

A different pattern emerges when the variation concerns selected critical indicators rather than the weights of the three phases. In this case, the final score becomes more responsive. The scenarios built around weaker post-event demand, delayed district activation, and higher operating burden produce a more visible downward shift in the assessment. The resulting range, equal to 0.776, is substantially wider than the one produced by the variation of main weights. This confirms a moderate sensitivity of the model to the indicators most closely linked to post-event consolidation.

Test family	Minimum	Maximum	Range
Main criteria weights	3.43	3.58	0.15
Critical indicators	3.15	3.93	0.78

Table 6.12 - Comparative range of sensitivity analysis results for main criteria weights and critical indicators. Source: author’s elaboration.

The meaning of this difference is quite direct. The model is less affected by how the three broad phases are weighted than by what happens inside the post-event operating profile of the venue. This is not a methodological weakness. On the contrary, it is consistent with the argument developed throughout the thesis. The long-term sustainability of Unipol Dome is not primarily uncertain because of the way the evaluation hierarchy has been constructed. It is uncertain because the arena has not yet demonstrated, in practice, the density, regularity and resilience of its future use. The sensitivity analysis therefore confirms that the real pressure points lie in the in-use phase, which is exactly where the legacy of an Olympic venue is ultimately tested.

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The critical downside scenarios are particularly instructive in this respect. The most penalising trajectories are those in which three conditions emerge simultaneously: weaker-than-expected demand, slower activation of the surrounding district, and a heavier operational burden. When annual intensity of use, regular occupancy, balance between activity level and operating effort, and urban relevance decline together, the final result shifts downward in a visible way. This suggests that the long-term value of the arena will depend less on the symbolic success of the Olympic event and much more on the consolidation of a stable and credible post-event operating ecology.

Seen from this perspective, the sensitivity analysis does more than test the robustness of the model. It also helps identify where the future trajectory of Unipol Dome is likely to be decided. The final score remains reasonably stable when the evaluative structure is rebalanced at the phase level. It becomes more volatile when the variables connected to use, demand and territorial integration are modified. This distinction is important. It means that the framework is methodologically stable, while the venue itself remains strategically exposed in those dimensions that cannot yet be fully verified through current evidence.

For this reason, the sensitivity analysis reinforces rather than weakens the overall interpretation of the case. Unipol Dome appears to possess a relatively solid design base and a sufficiently coherent delivery profile, but its long-term sustainability remains conditional on the success of the post-event phase. The model is therefore robust in form, but intentionally sensitive in substance. It remains stable where it should remain stable, and it reacts where the actual long-term risk of the project is concentrated.

The numerical details supporting this interpretation are provided in ANNEX D. The annex confirms that the framework is methodologically stable, while the final assessment remains more sensitive to post-event variables such as use intensity, event diversification, operating burden and district integration.

6.11. Methodological implications and usefulness of the framework

The framework developed in this chapter has a specific methodological value. It makes it possible to move from a broad interpretative discussion of Unipol Dome to a structured evaluation without pretending that the future of the arena is already fully knowable. That balance is one of the chapter's main gains.

A second useful implication lies in the combination of life-cycle logic and AHP-based weighting. Hossaini et al. (2015) had already shown the usefulness of linking sustainability assessment to life-cycle phases, while Fiore et al. (2020) demonstrate how AHP can support complex evaluation in the built environment. The present chapter brings these two strands together in a framework designed for a large-event venue rather than for a conventional building evaluation.

A third implication concerns transferability. The model is built for Unipol Dome, but its structure could be adapted to other venues developed for mega-events, provided that the hierarchy and indicators are recalibrated in relation to the specific case. The framework therefore has value beyond the immediate thesis, even if its present form remains closely tied to the Milanese arena.

The limits of the framework should nonetheless remain visible. The scoring of some in-use indicators remains partly *ex ante*. Real operation may later alter the arena's evaluative profile. These are not defects to conceal. They define the actual epistemic condition of the research.

6.12. Concluding remarks

This chapter has developed the methodological core of the thesis. Through a life-cycle AHP-based framework, it has been possible to translate the analytical findings of the previous chapters into a structured evaluative model composed of criteria, sub-criteria and indicators.

Unipol Dome emerges from this process as a venue with a favourable design profile and a moderately positive overall score, but also with visible areas of uncertainty concentrated in the in-use phase. The sensitivity analysis confirms that the most decisive variables are not abstract methodological assumptions, but the practical conditions that will determine whether the arena can become a dense, resilient and urbanly embedded post-event venue.

The chapter therefore performs a hinge function within the thesis. The previous chapters were needed to define the problem, reconstruct the context, analyse the case and identify relevant benchmarks. The present chapter turns that material into a structured evaluation. The next chapter will then build on this result, moving from assessment to scenarios and strategic directions for the long-term sustainability of Unipol Dome.

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The methodological material supporting the AHP structure, weighting process, scoring application and sensitivity analysis is collected in ANNEXES A, B, C and D.

7. Scenarios and strategic directions for the long-term sustainability of Unipol Dome

7.1. From evaluation to strategy: the role of scenario construction

The previous chapter provided a structured assessment of Unipol Dome through a life-cycle AHP-based framework. That step was necessary, but it was not sufficient. A score can clarify the present analytical position of a venue; it cannot explain how that position may evolve once the exceptional Olympic phase has ended and ordinary operation begins to impose its own rhythm.

The shift from evaluation to strategy is the point at which the analytical work developed so far becomes operational. Earlier chapters reconstructed the Olympic context, the design and delivery logic of the arena, the benchmark evidence from Richmond and London, and the weighted structure of the AHP model. The present chapter uses those elements to define possible long-term trajectories and to identify the conditions under which Unipol Dome may either consolidate its role or reveal fragilities that are not yet fully visible.

This position matters because Olympic venues are frequently judged too early or too late. They are praised when they are delivered, when the event is still protected by institutional enthusiasm, media exposure and political urgency. Or they are criticised years later, when underuse, cost pressure or weak integration have already become evident. Neither posture is particularly useful for the case examined here. Unipol Dome occupies an intermediate condition. It is no longer an abstract project, yet it has not yet produced a mature post-event record. The long-term question is open.

Scenario construction is therefore used as a disciplined form of anticipation. It does not aim to predict the future with mechanical precision. Rather, it organises plausible futures around the variables that the literature and the AHP framework identify as

most exposed: use intensity, event diversification, operating burden, governance continuity, environmental performance and urban integration.

This approach is consistent with the understanding of legacy proposed by Chen (2015), who treats Olympic legacy as a process that must be planned and managed rather than assumed. It is also coherent with Preuss and Plambeck's interpretation of venue legacy as something revealed through use, not through the mere existence of the building. Tang et al. (2024) make the same issue more severe in relation to Winter Olympic venues, where the white elephant risk emerges when post-event demand, operational capacity and spatial context fail to remain aligned.

Unipol Dome starts from a stronger position than many specialised Olympic facilities. It is multifunctional. It is located in a metropolitan market. It belongs to a wider regeneration project. It has not been conceived only for the Olympic fortnight. These conditions reduce some risks, but they do not remove them. A multifunctional arena can still become fragile if its calendar is irregular, if its business model depends on a narrow event base, if the surrounding district develops too slowly, or if operating costs grow faster than actual use.

The chapter is structured around this assumption. It first identifies the critical uncertainties and benchmark-derived drivers that shape the long-term performance of the venue. It then develops three trajectories: a fragile trajectory, an intermediate trajectory and a favourable trajectory. These scenarios are not treated as abstract narratives, but as configurations of measurable variables. The following sections translate them into a KPI framework, early warning indicators, a risk matrix and a strategic roadmap extending from 2026 to 2035. The final proposal focuses on governance, revenue diversification and community integration, because these are the dimensions most likely to determine whether Unipol Dome becomes a durable urban asset or remains a promising but incomplete project.

The monitoring tools connected to this strategic step are developed in greater detail in ANNEX E, where the KPI framework and risk matrix are reported as operational supports to the scenario analysis.

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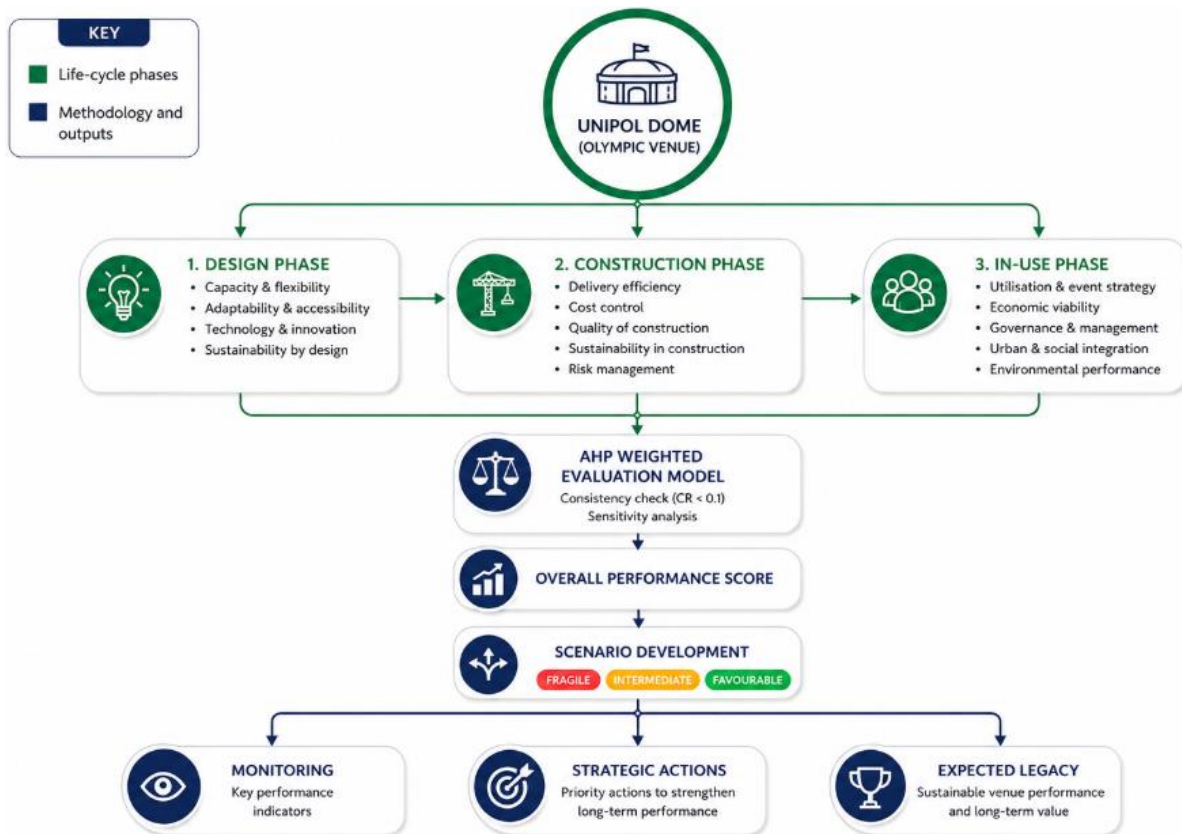


Figure 7.1 - Integrated life-cycle assessment model for Unipol Dome, linking evaluation phases, AHP scoring, scenarios and strategic legacy actions. Source: author's elaboration.

7.2. Critical uncertainties and benchmark-derived drivers

Before describing the scenarios, the variables that structure them must be made explicit. The drivers are derived from three sources: the benchmark analysis, the AHP-based evaluation and the sensitivity analysis.

The benchmark cases are useful because they show that successful post-event trajectories rarely depend on one isolated decision. Richmond Olympic Oval and London Aquatics Centre are different from Unipol Dome in typology, scale and

market position, but both make the same lesson visible: legacy becomes more robust when design adaptability, post-event planning, operational continuity and territorial integration reinforce one another over time. Davis (2020), in his analysis of London 2012 venues, shows that avoiding white elephants required attention not only to architectural quality but to transformation, downsizing and post-Games usability. The point is not that Unipol Dome should imitate London or Richmond. The point is that their stronger legacy profiles reveal what alignment looks like once it has had time to mature.

The AHP framework developed in Chapter 6 makes the same issue more specific. The highest exposure is concentrated in the in-use phase, especially in the indicators related to annual use, event diversity, operational balance, revenue diversification, maintenance resilience and underuse risk. This result is not surprising. Design and construction define the possibility of legacy, but operation decides whether that possibility becomes real.

Some variables therefore deserve closer attention.

The first is use intensity. A large arena cannot rely on symbolic visibility alone. It needs repeated activation. Preuss and Plambeck (2021) argue that utilisation is one of the clearest ways of observing whether an Olympic venue produces legacy or simply survives physically. For Unipol Dome, this means that the number of annual events matters, but so does their distribution across the year. A venue used intensely for a few clusters of events and left inactive for long periods would remain exposed.

The second variable is event diversification. The arena's multifunctional design is valuable only if it is matched by a diversified programme. Concerts may produce strong visibility and revenue, but an overdependence on concerts would make the model vulnerable to market fluctuations and promoter strategies. A stronger profile would include sports events, concerts, family shows, conventions, corporate events, cultural formats and possibly new entertainment categories such as esports or immersive digital events.

The third variable is operating burden. Barclay (2009) warned that mega-event cost-benefit narratives often underestimate the long-term weight of infrastructure once the event has ended. The same warning applies here, even if Unipol Dome is privately driven and commercially positioned. A venue may be active and still economically fragile if staffing, energy, maintenance, security and technical requirements remain disproportionate to actual use.

The fourth variable is district integration. Unipol Dome is not located in a neutral space. Its future is partly tied to the wider Milano Santa Giulia regeneration process. Brown (2020) and Essex and Sanchez (2024) both show that Olympic legacy is stronger when venues are absorbed into broader urban systems rather than left as isolated event objects. The arena's value will depend not only on what happens inside it, but also on whether the surrounding district becomes capable of supporting daily activity, accessibility, complementary services and urban continuity.

The fifth variable concerns governance. Garavelli (2024), writing on the governance of Milano-Cortina 2026, makes clear that Olympic delivery depends on a layered system of actors. That complexity does not disappear after the Games. It changes shape. Once the Olympic deadline has passed, the question becomes whether the venue is governed through clear responsibilities, transparent monitoring and long-term strategic coordination. Weak governance does not always produce visible failure immediately. It often acts slowly.

A final uncertainty concerns environmental performance in operation. Technical design may anticipate lower energy impact, but the real test begins with fluctuating occupancy, peak event loads and maintenance practice. Celani et al. (2023) and Tang et al. (2024) both support a life-cycle reading of built-environment sustainability. Applied to Unipol Dome, this means that environmental claims must be verified through operational data rather than accepted as design intention.

7.3. Fragile trajectory: weak post-event consolidation

The fragile trajectory is not the most likely scenario by default, but it is the one that should be taken most seriously from a risk-management perspective. It describes a condition in which Unipol Dome remains physically complete, formally operational and occasionally visible, yet fails to stabilise a sufficiently dense post-event role.

This is the most deceptive form of weakness. The venue would not necessarily appear abandoned. It might host concerts, selected sporting events and occasional large-scale formats. The problem would lie in discontinuity. A calendar concentrated in a limited number of high-profile events would create moments of intensity without producing stable activation. The arena would become recognisable, perhaps even successful in isolated periods, but it would not yet operate as a resilient urban asset.

Several mechanisms may push the venue in this direction.

A first mechanism is market overestimation. Multifunctionality is sometimes treated as if it automatically generated demand. It does not. A flexible venue can host different formats only if promoters, clubs, corporate users and audiences recognise it as convenient, accessible and commercially attractive. The Milanese event market is strong, but it is also competitive. If Unipol Dome fails to differentiate its position from other existing venues, its calendar could remain thinner than expected.

A second mechanism concerns the surrounding district. If Santa Giulia develops more slowly than planned, or if the arena opens before the district has reached a sufficient level of urban density, the venue may function primarily as an event-day destination. People would arrive for an event and leave immediately after. This pattern would weaken the broader urban legacy of the project. It would also reduce the chance that the arena becomes part of everyday metropolitan life.

A third mechanism is operational pressure. Large indoor arenas require complex technical management. Heating, cooling, ventilation, lighting, acoustics, crowd management, security and maintenance produce a heavy operational profile. If event frequency does not absorb these pressures, the economic balance becomes fragile. Tang et al. (2024) connect this type of imbalance directly to the white elephant risk: a venue does not need to be abandoned in order to become problematic. It may simply be underused relative to its cost and scale.

The fragile trajectory would also appear in social terms. The venue could remain commercially active while producing limited public relevance. That distinction matters. A legacy asset is not only a revenue machine. Chen (2015) suggests that Olympic legacy must be read through its capacity to generate durable and distributed value. If Unipol Dome becomes accessible only through expensive events and remains detached from local programming, its social contribution would be weak even if its commercial calendar were partially active.

The early warning signals would be visible quite soon. Irregular event distribution. High dependence on one event type. Limited local partnerships. Weak public use around the venue outside event days. Rising operating cost per event. Lack of annual performance reporting. None of these indicators alone would prove failure. Together, they would suggest that the arena is moving toward a fragile consolidation.

This scenario should not be interpreted as a collapse. It is more subtle. A venue may remain open, modern and symbolically connected to the Games while still producing an incomplete legacy. That is precisely why monitoring is needed.

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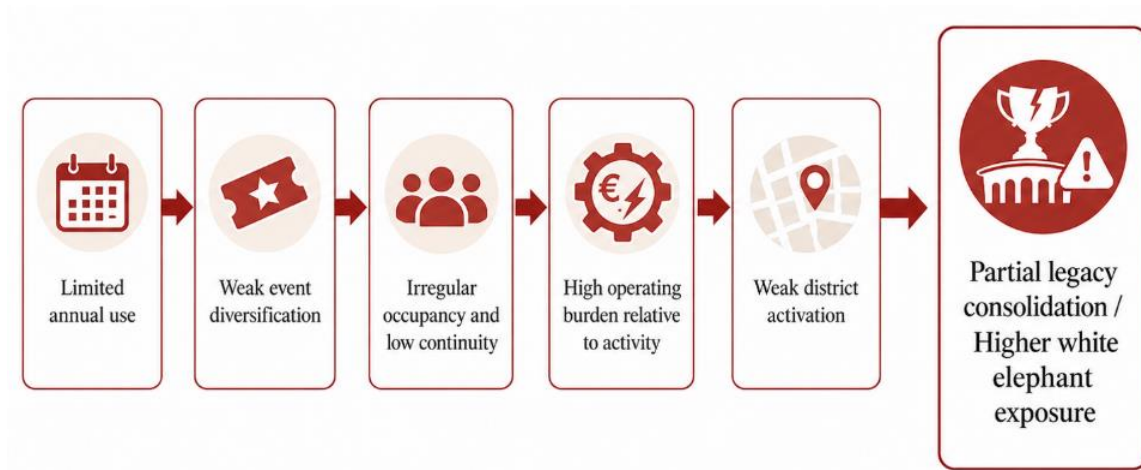


Figure 7.2 - Fragile trajectory scenario for Unipol Dome. Source: author's elaboration.

7.4. Intermediate trajectory: partial but incomplete consolidation

The intermediate trajectory is probably the most realistic early post-event condition. It describes a venue that succeeds in entering the metropolitan event market, builds recognisable visibility and hosts a varied set of events, but does not yet achieve full long-term resilience.

Unipol Dome would benefit from its metropolitan location, its multifunctional design and the visibility inherited from Milano-Cortina 2026. The Olympic association would help position the venue, at least during the first phase of operation. Concerts, sports events and entertainment formats would support public recognition. The arena would not appear as a weak project. On the contrary, it could be perceived as one of the most successful new infrastructures associated with the Games.

The difficulty would be deeper. The venue might be active without being fully consolidated. Event diversification could remain partial. Governance could be adequate but not yet systematic. Urban integration could improve but still depend heavily on the pace of Santa Giulia's wider development. Environmental performance might be monitored in general terms without becoming a precise management instrument.

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This is where the intermediate scenario differs from the favourable one. In the favourable trajectory, the main variables reinforce each other. In the intermediate trajectory, they coexist without yet forming a mature system.

A good event calendar would support visibility, but if the portfolio remained concentrated in a few profitable formats, resilience would be limited. District integration would improve with new public spaces, services and mobility connections, yet the venue might still be perceived mainly as an event facility rather than a piece of everyday city. Revenue streams would expand, but the model could remain exposed to promoter decisions, seasonal demand and cost pressure.

The intermediate trajectory is common in large venue development. It is also politically convenient, because it can be narrated as success. The risk is complacency. If early visibility is mistaken for durable legacy, the strategic work needed after the Games may lose urgency. Davis (2020) shows that the London 2012 venue legacy required active transformation and management after the event, not simply good initial design. The same logic applies here, although the typology is different.

For Unipol Dome, partial consolidation would mean that the venue has avoided the most evident white elephant symptoms but has not yet demonstrated robust long-term sustainability. It would remain a project with strong potential and unresolved exposure.

The KPI system becomes especially useful in this scenario. It can reveal whether the arena is gradually moving upward, toward a favourable trajectory, or whether it is stabilising at a level that remains too dependent on favourable market conditions. The difference may not be obvious from outside. It will appear in the data: event regularity, revenue diversification, operating burden, energy performance, technical reliability and district activation.

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Figure 7.3 - Intermediate trajectory scenario for Unipol Dome. Source: author's elaboration.

7.5. Favourable trajectory: durable integration and resilient use

The favourable trajectory describes the condition in which Unipol Dome succeeds in converting its initial advantages into a stable post-event role. Here the arena is not merely used. It is absorbed.

Use must be dense enough to justify the scale of the infrastructure, but not so narrow that the venue becomes dependent on a single market segment. The event portfolio should include large concerts and entertainment formats, but also sporting events, conventions, corporate uses, family shows and accessible community-related programming. The aim is not to dilute commercial ambition. It is to make it less brittle.

Economic sustainability would depend on the same logic. Revenue should not come only from ticketed events. A more resilient model would combine event income with hospitality, sponsorship, naming rights, corporate partnerships, premium services, food and beverage, media-related opportunities and selective digital experiences. This diversification would reduce exposure to fluctuations in any one market.

Operational performance would also need to mature. A technically advanced arena is not automatically efficient. It becomes efficient when systems are monitored, maintenance is planned, lessons from early operation are incorporated and energy

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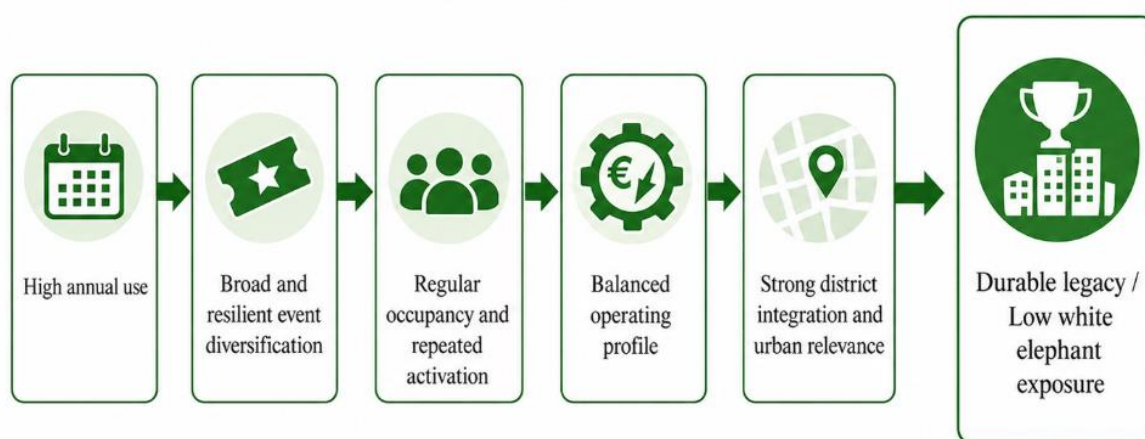
performance is measured in relation to actual use. Hossaini et al. (2015) and Zhu et al. (2020), although working in different built-environment and stadium-evaluation contexts, show the value of structured assessment systems where sustainability depends on multiple interacting criteria rather than on one isolated performance dimension.

The favourable trajectory also requires a more demanding urban condition. Unipol Dome should not remain an object placed inside Santa Giulia. It should help activate Santa Giulia. This means coordination with public spaces, transport nodes, retail functions, cultural uses, district events and pedestrian flows. The venue would then operate not only as a destination but as an anchor of urban life.

The Richmond and London benchmarks are useful here, though not as templates. Richmond shows how a venue can remain relevant when it hosts repeated, diversified and community-oriented uses after the Games. London demonstrates the value of transformation planning and long-term legibility within a wider urban park. Unipol Dome has a different commercial DNA, but the underlying principle is similar: a venue becomes stronger when its post-event identity is broad enough to survive beyond the memory of the Games.

The favourable scenario would be recognisable through several signals. Stable annual activation. A balanced event mix. Regular monitoring of operating costs and energy use. A visible relationship with Santa Giulia's public realm. Clear governance responsibilities. Annual performance review. Community access, even if selective. A revenue model not excessively dependent on one category.

At this stage, the Olympic legacy would no longer be mainly symbolic. It would become operational.



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Figure 7.4 - Favourable trajectory scenario for Unipol Dome. Source: author's elaboration.

7.6. Comparative reading of the three trajectories

The fragile trajectory is marked by discontinuity. The venue is present, but its use is too episodic. Its urban role remains thin. Its operating burden risks becoming heavy in relation to actual activation. The arena may still generate public attention, but attention is not legacy.

The intermediate trajectory is more ambiguous. It shows visible progress, regular events and partial diversification. Yet the system remains exposed because several variables improve without fully reinforcing each other. This is the scenario in which strategic discipline matters most. A venue in partial consolidation can still move upward, but it can also settle into mediocrity.

The favourable trajectory is defined by alignment. Use, revenue, governance, technical performance and urban integration begin to support one another. No single indicator proves success. The pattern does.

This comparative reading confirms one of the central arguments of the thesis. Olympic venue sustainability is not a fixed attribute. It is a condition produced over time. Preuss and Plambeck (2021) help make this visible through their emphasis on utilisation, while Tang et al. (2024) show the opposite condition through white elephant risk. Between these two poles lies the real challenge for Unipol Dome: avoiding the assumption that multifunctionality alone is enough.

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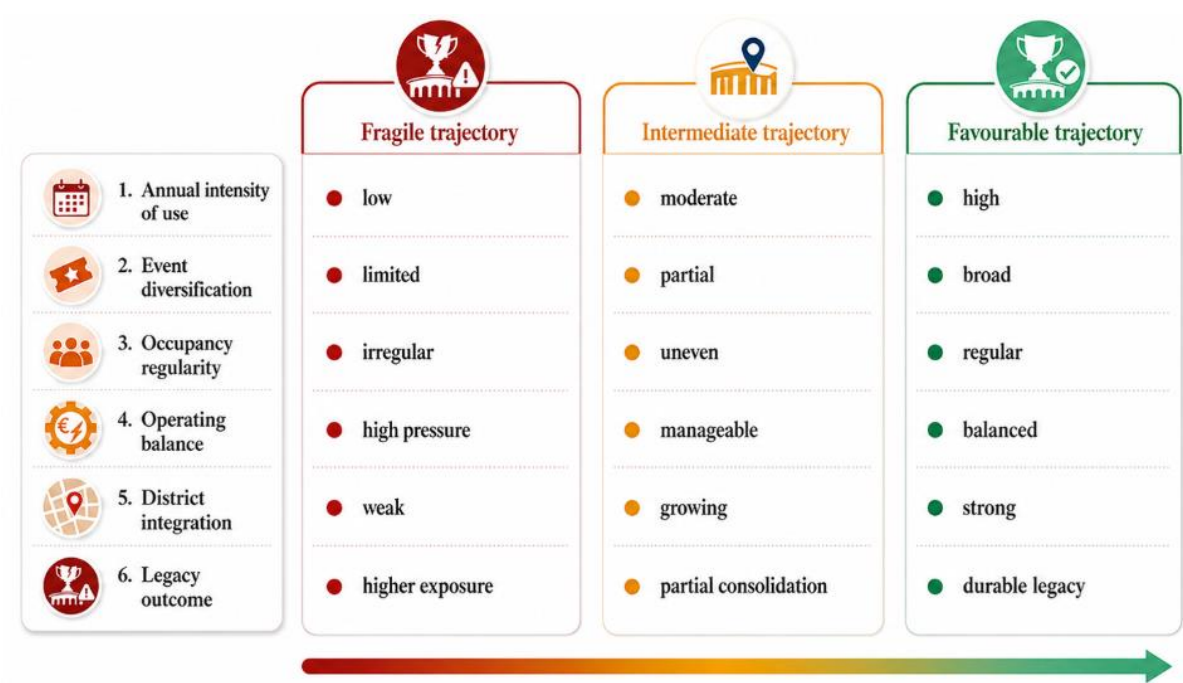


Figure 7.5 - Comparative scenario trajectories for Unipol Dome. Source: author’s elaboration.

7.7. KPI framework for long-term monitoring and early warning

The scenario structure becomes useful only if it is connected to monitoring. Without that passage, the chapter would describe possible futures but would not provide a way to recognise which one is emerging.

For this reason, the thesis proposes a reduced KPI framework. It is deliberately smaller than the full AHP indicator structure. The AHP model was designed to assess the venue across design, construction and use. The KPI framework serves another purpose. It selects the variables that are dynamic, observable and capable of signalling movement toward one trajectory or another.

The full KPI framework is reported in ANNEX E. The annex provides the complete monitoring structure and clarifies how each indicator contributes to the observation of Unipol Dome’s post-event trajectory.

The first KPI is use intensity and regularity. It measures whether Unipol Dome is repeatedly activated across the year. The number of events is relevant, but insufficient by itself. A regular rhythm of use matters because it indicates that the venue is becoming part of the ordinary event market rather than relying on isolated peaks.

The second KPI is event diversification. This indicator tracks the breadth of the event portfolio. A strong arena should not depend exclusively on concerts, sport or one promoter category. Diversification makes the model more resilient.

The third KPI concerns operating burden relative to activity. This is one of the most revealing indicators. A venue can appear successful in absolute terms while still being inefficient if the cost of operation is too high compared with its activation level. Here the monitoring logic should relate operating costs, maintenance intensity, staff requirements and event frequency.

The fourth KPI is operational and technical resilience. It captures whether the arena can sustain repeated use without disruptions, emergency maintenance or technical decline. This dimension is often neglected in public legacy narratives, but it becomes decisive in practice.

The fifth KPI concerns operational energy performance. The purpose is not to repeat design claims about sustainability. It is to test the building in use. Energy demand should be evaluated in relation to occupancy, event type, seasonal conditions and peak loads.

The sixth KPI is urban and district integration. This indicator observes whether the arena contributes to Santa Giulia beyond event days. Evidence may include footfall, public-space activation, mobility patterns, local partnerships and integration with surrounding functions.

Two further indicators strengthen the framework. Revenue diversification measures the distribution of income across different sources, while community accessibility captures whether the venue maintains some form of social and local relevance alongside commercial programming. These two KPIs are not secondary. They help prevent the arena from becoming economically narrow or socially distant.

The KPI framework should be reviewed quarterly during the first operating years and annually once the venue enters a more stable phase. The purpose is not bureaucratic control. It is strategic learning.

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7.7.1. Early warning indicators

Some signals deserve special attention because they reveal fragility before it becomes visible as failure.

The first warning signal is irregular use after the opening phase. Initial curiosity may produce a strong launch, but that effect can fade. If event density remains weak after the first full years of operation, the arena may be struggling to consolidate ordinary demand.

The second signal is excessive dependence on one event category. A concentration of more than half of annual events in one category would not automatically be negative, but it would require attention. Dependence is not the same as specialisation. It is exposure.

The third signal is an operating burden that grows faster than use. This condition would suggest that the venue is becoming heavy to manage, even if activity exists.

The fourth signal is technical discontinuity. Repeated maintenance problems, operational disruptions or avoidable cancellations would damage credibility in the promoter market and weaken user trust.

The fifth signal is weak environmental reporting. If energy performance is not monitored transparently, sustainability remains rhetorical.

The sixth signal is poor district activation outside event days. A venue that functions only when doors open for a ticketed event has not yet become an urban asset.

The final signal is governance opacity. If no actor is clearly responsible for monitoring performance, the legacy process becomes passive. That is dangerous. Legacy left unmanaged tends to become narrative rather than evidence.

7.8. Strategic roadmap for the consolidation of Unipol Dome

The strategic proposal is organised across three phases: stabilisation, consolidation and maturity. The time horizon extends from 2026 to 2035 because Olympic legacy cannot be assessed in the short term alone. A venue of this scale needs several operating cycles before its real profile becomes legible.

7.8.1. Phase I, 2026-2028: Stabilisation

The first phase begins with the Olympic event and the immediate post-Games transition. This is the most delicate period. The arena benefit from visibility, but visibility is temporary. The strategic task is to convert attention into operational continuity.

Three priorities dominate this phase:

- The first is securing a credible event pipeline. The calendar should not be improvised after the Games. Multi-year agreements, promoter relationships and diversified programming should already be active or under negotiation.
- The second priority is technical learning. The arena should be tested across different event types, attendance levels and operational conditions. Every major event should produce knowledge about staffing, energy demand, crowd flows, maintenance and user experience.
- The third priority is establishing the KPI system. Monitoring should begin early, before habits become fixed. A light but disciplined reporting structure would allow the operator to distinguish ordinary adjustment from structural weakness.

The expected outcome of this phase is not full maturity. It is controlled transition.

7.8.2. Phase II, 2028-2031: Consolidation

The second phase should broaden the venue's use base. By this stage, the novelty effect will have weakened. The arena will need to prove that it can operate through ordinary demand.

Event diversification becomes the main issue. Concerts and sport should remain visible, but the portfolio should expand toward corporate events, conventions, family entertainment, cultural programming and potentially esports or hybrid formats. The goal is not to fill the calendar at any cost. Low-quality activation would not strengthen legacy. The goal is to build a more resilient operating rhythm.

District integration should also become more concrete. The arena's relationship with Santa Giulia should be managed through public-space programming, coordinated mobility, local partnerships and complementary functions. The venue should begin to work with the district, not just within it.

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Energy performance should be refined during this phase. The first years of operation will reveal where systems behave efficiently and where adjustments are needed. A mature sustainability strategy should use that evidence.

7.8.3. Phase III, 2031-2035: Maturity

The third phase is the real legacy test. By this point, Olympic memory will no longer protect the venue. Unipol Dome will have to stand as a metropolitan asset in its own right.

Maturity would mean stable event demand, diversified revenue, clear governance, controlled operating burden and recognised urban relevance. It would also mean that the venue is no longer discussed primarily as an Olympic infrastructure. It would be understood as part of Milan's long-term event, cultural and regeneration system.

During this phase, benchmarking should be reintroduced. The arena's performance could be compared with selected European venues, not to reproduce their models but to test its own position. This would support strategic adjustment and prevent the venue from relying on outdated assumptions.

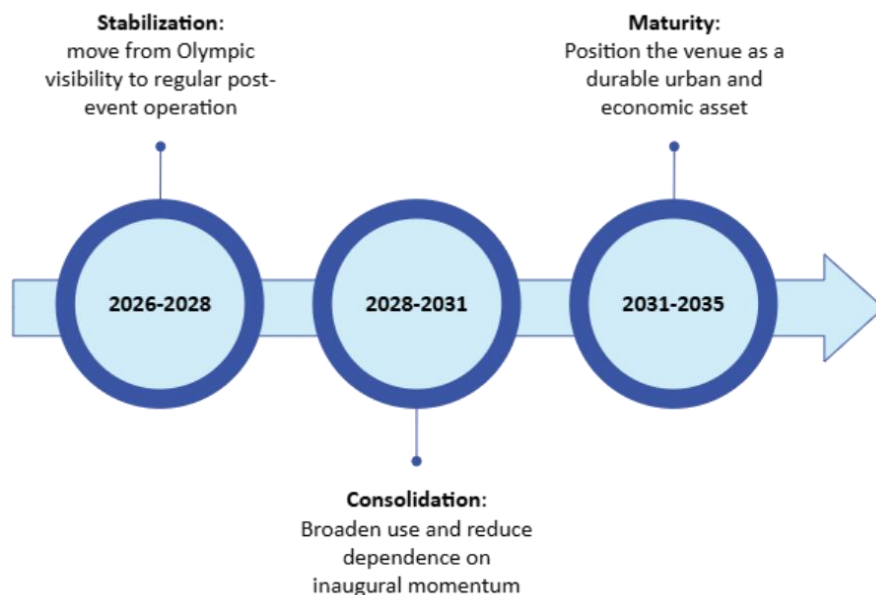


Figure 7.6 - Strategic roadmap for the long-term consolidation of Unipol Dome. Source: author's elaboration.

7.8.4. Governance recommendations

Governance is the silent infrastructure of legacy.

The first recommendation is to establish clear KPI ownership. Each indicator should have a responsible actor: operator, facility manager, commercial team, developer or public stakeholder. Without ownership, monitoring becomes decorative.

The second recommendation is to introduce an annual legacy review. This document should not be a promotional report. It should present event data, revenue diversification, technical performance, energy trends, district integration and risk signals. A concise public version would increase accountability.

The third recommendation is to maintain coordination between the venue and the Santa Giulia district. If the arena and district evolve separately, the urban legacy weakens. Regular coordination between operator, developer and local administration would help align programming, mobility and public-space activation.

The fourth recommendation concerns flexibility in management. The operator should not treat the first post-event business model as permanent. Markets change. Audience behaviour changes. Energy costs change. A resilient venue is one that learns.

7.8.5. Revenue diversification strategy

Revenue diversification is not simply a financial issue. It is a legacy issue. A venue whose income depends too heavily on one format becomes vulnerable, and vulnerability eventually affects maintenance, programming, accessibility and public relevance.

Live entertainment will probably remain one of the strongest components. Concerts and major shows can support visibility and high attendance. Sport should remain present, both because of the Olympic identity of the venue and because sporting events help maintain a broader user base. Corporate events and conventions can improve weekday activation. Hospitality, premium services and sponsorship may stabilise revenue beyond ticketing. Digital and media-related experiences can be explored selectively, without turning technological experimentation into an end in itself.

Community programming should not be treated as financially irrelevant. Its value lies elsewhere. It supports legitimacy, district integration and social recognition. A venue

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that is never accessible outside commercial formats risks becoming successful but narrow.

7.8.6. Community integration strategy

The community dimension should not be exaggerated, but neither should it be ignored.

Unipol Dome is not a civic sports centre. It is a large multifunctional arena with a commercial operating logic. Pretending otherwise would weaken the analysis. Yet a venue of this scale, built within an Olympic and regeneration context, cannot be evaluated only through commercial efficiency.

The question is not whether the arena becomes everyday public infrastructure in the ordinary sense. It will not. The question is whether it creates some forms of repeated, recognisable and accessible public value.

That value may come through school programmes, local partnerships, selected community events, open days, sports-related initiatives, cultural formats, district festivals or collaboration with local associations. Even limited programmes can matter if they are regular and visible. Social legacy is not produced by occasional gestures made for communication purposes. It requires repetition.

This is where Unipol Dome can avoid one of the typical weaknesses of large arenas: becoming a closed object activated only by ticketed demand. The stronger alternative is a venue that remains commercially ambitious but socially legible.

7.8.7. Risk matrix for long-term sustainability

The risk matrix developed in this section should be read as the operational counterpart of the scenario analysis. The scenarios describe how the long-term trajectory of Unipol Dome may evolve; the risk matrix identifies the pressures that may push the venue toward a weaker configuration if they are not monitored and addressed in time.

The complete risk matrix is reported in ANNEX E. The table identifies the main risk categories, their potential impact on the long-term sustainability of Unipol Dome and the monitoring logic through which they can be observed over time.

This distinction is relevant. Risk, in the case of Olympic venues, rarely appears as a sudden event. It usually emerges through accumulation. A calendar becomes less

regular. The event portfolio narrows. Operating costs rise more quickly than activity. The surrounding district develops more slowly than expected. Governance responsibilities become blurred. None of these signals is decisive in isolation. Together, however, they may gradually move a venue from a favourable or intermediate trajectory toward a fragile one.

The matrix therefore focuses on seven categories of risk: underutilisation, market saturation, weak district development, governance fragmentation, energy cost escalation, revenue concentration and loss of public relevance. These risks were selected because they correspond to the most exposed dimensions identified in the AHP framework and in the previous scenario analysis. They also reflect recurrent weaknesses discussed in the literature on Olympic legacy and white elephant formation, where the long-term problem is often not the physical absence of use, but the mismatch between scale, cost, demand and urban integration.

Underutilisation represents the most severe risk. Its impact extends across almost all dimensions of the venue's sustainability. If Unipol Dome is not activated regularly, economic viability weakens, revenue diversification becomes harder, the environmental justification of the building becomes more fragile and the wider urban role of the arena remains limited. This is the risk most closely associated with the white elephant mechanism described by Tang et al. (2024), although in this case the danger would probably take the form of partial underperformance rather than abandonment.

Market saturation is different. It does not depend only on the quality of Unipol Dome, but on the position of the arena within the wider Milanese and regional event system. Milan offers a strong metropolitan market, yet strength does not eliminate competition. The arena will need to define a recognisable profile in relation to existing venues, promoters, sports organisations and entertainment formats. If its positioning remains too generic, multifunctionality may become less an advantage than a diluted identity.

Weak district development is another high-impact risk. The arena is embedded in the Santa Giulia regeneration process, and this relationship is one of the main reasons why the project may produce a broader urban legacy. If the surrounding district remains incomplete, poorly activated or weakly connected to everyday urban flows, Unipol Dome may function mainly as an event-day destination. The venue would still operate, but its territorial value would remain narrower than expected. This risk is particularly relevant because urban integration cannot be produced by the

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arena alone. It depends on the timing, quality and continuity of the district transformation around it.

Governance fragmentation is less visible, but it may be equally damaging over time. A venue can survive several years with unclear monitoring responsibilities, weak coordination between actors or limited public reporting. The effects appear later: slow reaction to performance decline, inconsistent strategic choices, fragmented accountability and difficulty in correcting emerging weaknesses. Garavelli's analysis of Milano-Cortina 2026 governance is useful here because it shows how layered actor systems can support delivery, but also require continuity once the event phase has passed.

Energy cost escalation deserves specific attention. Large indoor arenas are technically demanding buildings, and their environmental performance cannot be assessed only through design intentions. A rise in energy costs, combined with irregular utilisation, may affect both economic and environmental sustainability. For this reason, operational energy performance should be monitored as a managerial risk, not only as a sustainability indicator.

Revenue concentration is a more subtle exposure. Strong early performance may conceal dependence on a limited number of event types, commercial partners or income streams. A venue that relies too heavily on concerts, sponsorship or one dominant promoter may appear successful in the short term while remaining vulnerable to market changes. Diversification is therefore not only a financial objective; it is a condition of resilience.

The final risk concerns public relevance. This is the least immediate risk, but it should not be underestimated. Unipol Dome may become commercially active and still remain socially thin. For a venue associated with the Olympic Games and inserted into a major urban regeneration project, such an outcome would represent an incomplete legacy. Public relevance does not require the arena to become an everyday civic facility, but it does require some repeated connection with the surrounding community, local institutions and wider urban life.

The risk matrix should therefore be interpreted as an early-warning device. Its purpose is not to predict failure, nor to suggest that Unipol Dome is structurally exposed to negative outcomes. On the contrary, the arena starts from a relatively favourable position. The matrix clarifies which variables must remain under control if that position is to be preserved. In this sense, risk assessment becomes part of the legacy strategy itself: it translates the abstract possibility of underperformance

into observable conditions, making corrective action possible before weakness becomes structural.

7.9. Concluding remarks

This chapter has treated Unipol Dome as a venue in transition rather than as a completed legacy asset. That distinction is essential. The arena already presents several favourable conditions: a multifunctional concept, metropolitan location, Olympic visibility, technical ambition and a position within a wider regeneration project. These features justify cautious optimism.

The scenario analysis shows that the long-term outcome will depend on the alignment between use, operating balance, governance, revenue diversification, environmental performance and urban integration. The fragile trajectory would emerge if those variables remain disconnected. The intermediate trajectory would reflect partial success, visible but not yet secure. The favourable trajectory would require the arena to become not only active, but resilient.

The KPI framework and risk matrix translate this argument into a monitoring structure. They make it possible to observe whether the venue is moving toward consolidation or whether early signs of fragility are appearing. The strategic roadmap then identifies the work required across three phases: stabilisation after the Games, consolidation of the event and revenue base, and maturity as a long-term urban asset.

The final point is straightforward. Unipol Dome will not avoid the white elephant risk because it is new, flexible or located in Milan. It will avoid that risk only if its post-event life is actively governed, measured and adapted. Legacy is not the memory of the Olympic event. It is the quality of what remains useful after that memory begins to fade.

Conclusion

This thesis examined the long-term sustainability of Unipol Dome within the framework of the Milan-Cortina 2026 Winter Olympic and Paralympic Games. The research started from a tension that remains central to the study of Olympic infrastructures: the Games are temporary, while the venues they generate may remain part of the urban and economic system for decades. This asymmetry makes venue legacy difficult to assess. A building may satisfy Olympic requirements and still become weak in its ordinary post-event life. The real test begins after the event.

The case of Unipol Dome is particularly relevant because it does not correspond to the most typical profile of Olympic risk. It is not a highly specialised winter facility located in a marginal context. It is a multifunctional arena, positioned within the Milan metropolitan market and embedded in the wider Milano Santa Giulia regeneration process. These conditions give the venue a comparatively favourable starting point. They do not, however, guarantee a successful legacy. The main argument developed throughout the thesis is that the long-term value of an Olympic arena depends less on its formal multifunctionality than on the capacity to convert that multifunctionality into regular use, operational balance, diversified revenues and urban integration.

The analysis showed that Unipol Dome should be understood as a venue in transition rather than as an already accomplished legacy asset. Its Olympic role is clear, but its post-event performance remains prospective. This is why an ex-post evaluation would be premature and why the thesis adopted a life-cycle approach. Design, construction and use were treated as interconnected phases, each capable of strengthening or weakening the future trajectory of the arena. Legacy, in this sense, is not an outcome that appears after the Games as a separate matter. It is progressively prepared, constrained and tested over time.

The comparative analysis of Richmond Olympic Oval and London Aquatics Centre supported this interpretation. The benchmark cases did not provide direct models to be replicated. Their value lies in the conditions they made visible: early anticipation of post-event use, adaptability, coherent management, diversified programming and integration within a broader urban or community setting. These cases confirmed that stronger Olympic legacies tend to emerge from alignment. Isolated design quality is not enough. Nor is symbolic visibility. A venue becomes durable when its spatial

configuration, operating model, governance structure and territorial context reinforce one another.

The main methodological contribution of the thesis is the development of a life-cycle AHP framework for the assessment of Olympic arenas before their mature post-event performance can be observed. The framework translated the qualitative evidence emerging from literature, case analysis, benchmark comparison and expert-informed judgement into weighted criteria and indicators. This allowed the research to move beyond a purely descriptive assessment of Unipol Dome and to produce a structured evaluation of its long-term sustainability potential.

The results indicate a favourable but not risk-free profile. Unipol Dome performs strongly in relation to design logic, multifunctional configuration and strategic location. Its most exposed dimension is the in-use phase. This finding is coherent with the theoretical position of the thesis: the decisive question for Olympic venues is not only how they are conceived or delivered, but how they behave once the exceptional conditions of the Games have disappeared. Use intensity, event diversification, operating burden, governance continuity, revenue structure, energy performance and district integration emerge as the variables most likely to determine the arena's long-term trajectory.

The sensitivity analysis strengthened this conclusion. Moderate changes in the weighting structure did not radically alter the overall assessment, suggesting that the framework is reasonably stable. At the same time, the sensitivity tests confirmed that the operational variables remain the most delicate part of the evaluation. This is not a methodological weakness. It reflects the nature of the case. Unipol Dome has not yet entered a mature phase of ordinary operation, and several of the indicators that matter most for legacy can only be verified over time.

For this reason, the scenario analysis developed in the final chapter was necessary. Three trajectories were identified. The fragile trajectory describes a condition in which the venue remains active but insufficiently consolidated, with irregular use, narrow programming and limited urban embeddedness. The intermediate trajectory represents partial success: the arena gains visibility and hosts significant events, but its long-term resilience remains incomplete. The favourable trajectory depends on a stronger configuration, where event density, diversified revenues, technical reliability, governance and district integration become mutually reinforcing.

The strategic proposal derived from these scenarios is deliberately operational. The KPI framework, early warning indicators and risk matrix are not accessory outputs.

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They are instruments through which the legacy process can be monitored before weaknesses become structural. Underutilisation, market saturation, weak district development, governance fragmentation, energy cost escalation, revenue concentration and loss of public relevance should be read as cumulative risks. They rarely appear all at once. They develop through small misalignments that, if ignored, may progressively reduce the capacity of the venue to operate as a sustainable asset.

The thesis therefore concludes that Unipol Dome can avoid white elephant dynamics only under certain conditions. Its post-event life must be actively governed, measured and adapted. Multifunctionality must become diversified programming. Metropolitan location must translate into accessibility, demand and territorial continuity. Sustainability must be verified through operational performance rather than assumed through project intentions. The surrounding Santa Giulia district must not remain a background condition, but become part of the venue's ordinary urban logic.

The contribution of the research is twofold. Empirically, it provides a structured reading of Unipol Dome as one of the most significant venues through which the sustainability narrative of Milan-Cortina 2026 will be tested. Methodologically, it proposes an assessment framework that may be adapted to other Olympic or major-event arenas, particularly in cases where long-term performance is not yet observable. The framework does not predict legacy with certainty. It identifies the conditions that make stronger or weaker trajectories more plausible.

The final position of the thesis is therefore cautious but clear. Unipol Dome starts from a strong condition, but its legacy is not already secured. It will depend on the quality of its ordinary life after the Games: how often it is used, how broadly it is programmed, how efficiently it is managed, how visibly it belongs to the surrounding district, and how quickly emerging risks are recognised and corrected.

Legacy is not the memory of the Olympic event. It is the quality of what remains useful after that memory begins to fade.

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ANNEX A- AHP structure and pairwise comparison matrix

Main criteria	Sub-criteria	Indicators
C1 Design and planning phase	C1.1 Functional and spatial strategy	I1 Post-event functional adaptability
		I2 Capacity adequacy for long-term demand
		I3 Spatial flexibility of layout
	C1.2 Technical and energy strategy	I4 Integration of renewable energy systems
		I5 Energy-conscious plant concept
		I6 Design for operational efficiency and maintainability
	C1.3 Financial and governance setting	I7 Clarity of ownership and governance model
		I8 Consistency of investment structure
		I9 Alignment between Olympic function and long-term business model
	C1.4 Urban integration and legacy by design	I10 Accessibility and multimodal connectivity by design
		I11 Integration with surrounding district functions
		I12 Explicit consideration of post-event legacy in planning
C2 Construction phase	C2.1 Delivery and schedule control	I13 Compliance with Olympic delivery timeline
		I14 Continuity and reliability of construction process
		I15 Readiness for transition from construction to operation
	C2.2 Cost and procurement robustness	I16 Cost control during delivery
		I17 Procurement and contractor coordination effectiveness
		I18 Resilience to schedule-cost pressure
	C2.3 Environmental performance in construction	I19 Use of low-carbon and lower-impact materials
		I20 Embodied carbon mitigation measures
		I21 Construction waste and logistics efficiency
	C2.4 Construction quality and risk control	I22 Construction quality assurance
		I23 Risk management and compliance control
		I24 Consistency between planned and delivered performance
C3 In-use phase	C3.1 Functional intensity and diversification	I25 Annual intensity of use
		I26 Diversity of hosted event types
		I27 Occupancy and utilisation regularity
	C3.2 Operational and economic sustainability	I28 Balance between operating burden and activity level
		I29 Revenue diversification potential
		I30 Maintenance and operational resilience
	C3.3 Energy and environmental performance in operation	I31 Operational energy efficiency
		I32 Ability to manage peak demand during major events
		I33 Environmental performance under varying occupancy conditions
	C3.4 Urban, social and legacy performance	I34 Contribution to district activation
		I35 Public and urban relevance beyond event days
		I36 Risk of underuse / white elephant exposure

Table A - Life-cycle phases, sub-criteria and indicators of the AHP framework. Source: author's elaboration.

Annex A presents the general structure of the life-cycle AHP framework developed in the thesis and reports the pairwise comparison matrices related to the main criteria and to the sub-criteria of the three life-cycle phases. Its function is to clarify the methodological passage through which the broad concept of long-term venue sustainability has been translated into an evaluative hierarchy.

The annex does not introduce a separate analytical argument. It supports Chapter 6 by showing the internal architecture of the model. As shown in Table A, the framework is organised around the overall objective of assessing the long-term sustainability potential of Unipol Dome as an Olympic venue. This objective is then articulated into three main criteria: design and planning phase, construction phase, and in-use phase.

These phases are not treated as neutral chronological steps. They correspond to three different forms of influence on the future performance of the asset. The design and planning phase defines the initial potential of the venue. At this stage, decisions concerning capacity, flexibility, accessibility, technical configuration and environmental strategy create the conditions under which future use may become easier or more constrained. A venue can already become fragile in design, even if that fragility only becomes visible years later.

The construction phase concerns the reliability of delivery. In Olympic-related projects, construction is exposed to fixed deadlines, public pressure, coordination complexity and cost-control issues. This phase does not determine legacy by itself, but it can affect the technical quality, economic balance and operational resilience of the venue.

The in-use phase represents the moment in which legacy becomes observable. Use intensity, event diversification, operating burden, governance continuity, revenue structure, environmental performance and urban integration are tested only after the exceptional Olympic phase has ended. For this reason, the in-use phase receives particular relevance within the framework.

	design and planning	construction	in-use
design and planning	1	1	0,50
construction	1	1	0,50
in-use	2	2	1

normalized

	design and planning	construction	in-use	local weight	A*w	λ
design and planning	0,25	0,25	0,25	0,25	0,75	3
construction	0,25	0,25	0,25	0,25	0,75	3

in-use	0,5	0,5	0,5	0,5	1,5	3
consistency check						
λ	3					
CI	0					
RI	0,58					
CR	0					
acceptable ?	yes					

Table A.1 - Pairwise comparison matrix of the main life-cycle criteria. Source: author's elaboration

Table A.1 reports the pairwise comparison matrix of the main criteria. This matrix defines the relative importance assigned to the three life-cycle phases in relation to the overall objective. The comparison was carried out using Saaty's 1–9 scale, where each element is evaluated against another element belonging to the same level of the hierarchy. This method avoids the direct and opaque assignment of weights. It forces priorities to be expressed through repeated bilateral judgements.

	Functional and spatial strategy	Technical and energy strategy	Financial and governance setting	Urban integration and legacy by design			
Functional and spatial strategy	1	1	3,00	3			
Technical and energy strategy	1	1	3,00	3			
Financial and governance setting	0,33	0,33	1	1			
Urban integration and legacy by design	0,33	0,33	1	1			
	Functional and spatial strategy	Technical and energy strategy	Financial and governance setting	Urban integration and legacy by design	local weight	A*w	λ
Functional and spatial strategy	0,375	0,375	0,38	0,375	0,375	1,50	4
Technical and energy strategy	0,375	0,375	0,38	0,375	0,375	1,50	4
Financial and governance setting	0,125	0,125	0,125	0,125	0,125	0,5	4
Urban integration and legacy by design	0,125	0,125	0,125	0,125	0,125	0,5	4
λ	4						
CI	0						
RI	0,9						
CR	0						
acceptable ?	yes						

Table A.2 - Pairwise comparison matrix of the design-phase sub-criteria. Source: author's elaboration

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	Delivery and schedule control	Cost and procurement robustness	Environmental performance in construction	Construction quality and risk control
Delivery and schedule control	1	2	3	2
Cost and procurement robustness	0,5	1	2	1
Environmental performance in construction	0,33	0,5	1	0,5
Construction quality and risk control	0,5	1	2	1

	Delivery and schedule control	Cost and procurement robustness	Environmental performance in construction	Construction quality and risk control	local weight	A*w	λ
Delivery and schedule control	0,43	0,44	0,38	0,44	0,42	1,70	4
Cost and procurement robustness	0,21	0,22	0,25	0,22	0,23	0,91	4
Environmental performance in construction	0,14	0,11	0,13	0,11	0,12	0,49	4
Construction quality and risk control	0,21	0,22	0,25	0,22	0,23	0,91	4

λ	4
CI	0
RI	0,9
CR	0,00
acceptable ?	yes

Table A.3 - Pairwise comparison matrix of the construction-phase sub-criteria. Source: author's elaboration.

	Functional intensity and diversification	Operational and economic sustainability	Energy and environmental performance in operation	Urban, social and legacy performance
Functional intensity and diversification	1	2	3	2
Operational and economic sustainability	0,5	1	2	1
Energy and environmental performance in operation	0,33	0,5	1	0,5
Urban, social and legacy performance	0,5	1	2	1

	Functional intensity and diversification	Operational and economic sustainability	Energy and environmental performance in operation	Urban, social and legacy performance	local weight	A*w	λ
Functional intensity and diversification	0,43	0,44	0,38	0,44	0,42	1,70	4
Operational and economic sustainability	0,21	0,22	0,25	0,22	0,23	0,91	4
Energy and environmental performance in operation	0,14	0,11	0,13	0,11	0,12	0,49	4
Urban, social and legacy performance	0,21	0,22	0,25	0,22	0,23	0,91	4

λ	4
CI	0
RI	0,9
CR	0
acceptable ?	yes

Table A.4 - Pairwise comparison matrix of the in-use phase sub-criteria. Source: author's elaboration.

Tables A.2, A.3 and A.4 report the pairwise comparison matrices for the sub-criteria of the design and planning phase, construction phase and in-use phase respectively. Within the design phase, the comparison focuses on the relative relevance of the

elements that shape post-event adaptability and strategic coherence. Within the construction phase, the matrix clarifies the importance assigned to delivery efficiency, cost control, construction quality, sustainability in construction and risk management. Within the in-use phase, the comparison highlights the greater exposure of operational, managerial and urban variables.

The matrices included in this annex should therefore be read as the foundation of the evaluative model. They show what the framework considers relevant and why certain dimensions are given greater analytical weight than others. The aim is not to present the model as a neutral mechanical device. The aim is to make the evaluative logic traceable.

This point is particularly relevant for the case of Unipol Dome. The arena has not yet produced a mature post-Olympic operational record. Its assessment therefore requires an ex-ante framework capable of organising available evidence, benchmark insights and prospective judgement. Annex A documents the first step of that process: the construction of the hierarchy.

ANNEX B- Indicator weighting system

Annex B reports the pairwise comparison matrices developed at indicator level, together with the related consistency checks, local weights and global weights. It represents the most detailed methodological layer of the AHP framework.

If Annex A defines the general architecture of the model, Annex B shows how that architecture is translated into operational priorities. The indicators are the level at which the framework becomes directly usable for evaluation. They connect the theoretical categories discussed in the thesis with concrete dimensions that can be assessed in relation to Unipol Dome and to the selected benchmark venues.

Tables B.1 to B.12 report the pairwise comparison matrices of the indicators grouped under their respective sub-criteria: each table compares indicators belonging to the same analytical group and establishes their relative contribution to the parent sub-criterion.

The pairwise comparison of indicators follows the same AHP logic applied to the higher levels of the hierarchy. Indicators belonging to the same sub-criterion are compared two at a time in relation to their contribution to the parent criterion. This procedure allows the model to distinguish between indicators that may appear similar but do not carry the same influence on long-term sustainability.

Indicators C 1.1

	Post-event functional adaptability	Capacity adequacy for long-term demand	Spatial flexibility of layout
Post-event functional adaptability	1	3	4
Capacity adequacy for long-term demand	0,33	1	2
Spatial flexibility of layout	0,25	0,5	1

	Post-event functional adaptability	Capacity adequacy for long-term demand	Spatial flexibility of layout	local weight	A*w	λ
Post-event functional adaptability	0,63	0,67	0,57	0,62	1,89	3
Capacity adequacy for long-term demand	0,21	0,22	0,29	0,24	0,72	3
Spatial flexibility of layout	0,16	0,11	0,14	0,14	0,41	3

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λ	3
CI	0
RI	0,58
CR	0,02
acceptable ?	yes

Table B.1 – Design and planning indicators (Functional and spatial strategy). Source: author's elaboration.

Indicators C 1.2

	Integration of renewable energy systems	Energy- conscious plant concept	Design for operational efficiency and maintainability
Integration of renewable energy systems	1	0,33	0,5
Energy-conscious plant concept	3,00	1	2,00
Design for operational efficiency and maintainability	2	0,5	1

	Integration of renewable energy systems	Energy- conscious plant concept	Design for operational efficiency and maintainability	local weight	A*w	λ
Integration of renewable energy systems	0,17	0,18	0,14	0,16	0,49	3
Energy-conscious plant concept	0,50	0,55	0,57	0,54	1,62	3
Design for operational efficiency and maintainability	0,33	0,27	0,29	0,30	0,89	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.2 – Design and planning indicators (Technical and energy strategy). Source: author's elaboration.

Indicators C 1.3

	Clarity of ownership and governance model	Consistency of investment structure	Alignment between Olympic function and long-term business model			
Clarity of ownership and governance model	1	2	0,5			
Consistency of investment structure	0,50	1	0,33			
Alignment between Olympic function and long-term business model	2	3	1			
	Clarity of ownership and governance model	Consistency of investment structure	Alignment between Olympic function and long-term business model	local weight	A*w	λ
Clarity of ownership and governance model	0,29	0,33	0,27	0,30	0,89	3
Consistency of investment structure	0,14	0,17	0,18	0,16	0,49	3
Alignment between Olympic function and long-term business model	0,57	0,50	0,55	0,54	1,62	3
λ	3					
CI	0					
RI	0,58					
CR	0					
acceptable ?	yes					

Table B.3 – Design and planning indicators (Financial and governance setting). Source: author's elaboration.

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Indicators C 1.4

	Accessibility and multimodal connectivity by design	Integration with surrounding district functions	Explicit consideration of post-event legacy in planning
Accessibility and multimodal connectivity by design	1	2	1
Integration with surrounding district functions	0,50	1	0,50
Explicit consideration of post-event legacy in planning	1	2	1

	Accessibility and multimodal connectivity by design	Integration with surrounding district functions	Explicit consideration of post-event legacy in planning	local weight	A*w	λ
Accessibility and multimodal connectivity by design	0,4	0,4	0,4	0,4	1,2	3
Integration with surrounding district functions	0,20	0,2	0,20	0,20	0,60	3
Explicit consideration of post-event legacy in planning	0,4	0,4	0,4	0,4	1,2	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.4 – Design and planning indicators (Urban integration and legacy by design). Source: author's elaboration.

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Indicators C2.1

	Compliance with Olympic delivery timeline	Continuity and reliability of construction process	Readiness for transition from construction to operation
Compliance with Olympic delivery timeline	1	2	3
Continuity and reliability of construction process	0,50	1	2
Readiness for transition from construction to operation	0,33	0,5	1

	Compliance with Olympic delivery timeline	Continuity and reliability of construction process	Readiness for transition from construction to operation	local weight	A*w	λ
Compliance with Olympic delivery timeline	0,55	0,57	0,50	0,54	1,62	3
Continuity and reliability of construction process	0,27	0,29	0,33	0,30	0,89	3
Readiness for transition from construction to operation	0,18	0,14	0,17	0,16	0,49	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.5 – Construction indicators (Delivery and schedule control). Source: author's elaboration.

Indicators C2.2

	Cost control during delivery	Procurement and contractor coordination effectiveness	Resilience to schedule- cost pressure
Cost control during delivery	1	1	2
Procurement and contractor coordination effectiveness	1	1	2
Resilience to schedule-cost pressure	0,50	0,5	1

	Cost control during delivery	Procurement and contractor coordination effectiveness	Resilience to schedule- cost pressure	local weight	A*w	λ
Cost control during delivery	0,4	0,4	0,4	0,4	1,2	3
Procurement and contractor coordination effectiveness	0,4	0,4	0,4	0,4	1,2	3
Resilience to schedule-cost pressure	0,2	0,2	0,2	0,2	0,6	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.6 – Construction indicators (Cost and procurement robustness). Source: author's elaboration.

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Indicators C2.3

	Use of low-carbon and lower-impact materials	Embodied carbon mitigation measures	Construction waste and logistics efficiency
Use of low-carbon and lower-impact materials	1	0,5	2
Embodied carbon mitigation measures	2,00	1	3,00
Construction waste and logistics efficiency	0,50	0,33	1,00

	Use of low-carbon and lower-impact materials	Embodied carbon mitigation measures	Construction waste and logistics efficiency	local weight	A*w	λ
Use of low-carbon and lower-impact materials	0,29	0,27	0,33	0,30	0,89	3
Embodied carbon mitigation measures	0,57	0,55	0,50	0,54	1,62	3
Construction waste and logistics efficiency	0,14	0,18	0,17	0,16	0,49	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.7 – Construction indicators (Environmental performance in construction). Source: author's elaboration.

Indicators C2.4

	Construction quality assurance	Risk management and compliance control	Consistency between planned and delivered performance			
Construction quality assurance	1	1	2			
Risk management and compliance control	1,00	1	2,00			
Consistency between planned and delivered performance	0,50	0,5	1,00			
	Construction quality assurance	Risk management and compliance control	Consistency between planned and delivered performance	local weight	A*w	λ
Construction quality assurance	0,4	0,4	0,4	0,4	1,2	3
Risk management and compliance control	0,40	0,4	0,40	0,40	1,20	3
Consistency between planned and delivered performance	0,20	0,2	0,20	0,20	0,60	3
λ	3					
CI	0					
RI	0,58					
CR	0					
acceptable ?	yes					

Table B.8 – Construction indicators (Construction quality and risk control). Source: author's elaboration.

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Indicators C3.1

	Annual intensity of use	Diversity of hosted event types	Occupancy and utilisation regularity
Annual intensity of use	1	2	3
Diversity of hosted event types	0,50	1	2,00
Occupancy and utilisation regularity	0,33	0,50	1,00

	Annual intensity of use	Diversity of hosted event types	Occupancy and utilisation regularity	local weight	A*w	λ
Annual intensity of use	0,55	0,57	0,50	0,54	1,62	3
Diversity of hosted event types	0,27	0,29	0,33	0,30	0,89	3
Occupancy and utilisation regularity	0,18	0,14	0,17	0,16	0,49	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.9 – In-use indicators (Functional intensity and diversification). Source: author's elaboration.

Indicators C3.2

	Balance between operating burden and activity level	Revenue diversification potential	Maintenance and operational resilience
Balance between operating burden and activity level	1	2	1
Revenue diversification potential	0,50	1	0,50
Maintenance and operational resilience	1,00	2	1,00

	Balance between operating burden and activity level	Revenue diversification potential	Maintenance and operational resilience	local weight	A*w	λ
Balance between operating burden and activity level	0,4	0,4	0,4	0,4	1,2	3
Revenue diversification potential	0,20	0,2	0,20	0,20	0,60	3
Maintenance and operational resilience	0,40	0,4	0,40	0,40	1,20	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.10 – In-use indicators (Operational and economic sustainability). Source: author's elaboration.

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Indicators C3.3

	Operational energy efficiency	Ability to manage peak demand during major events	Environmental performance under varying occupancy conditions
Operational energy efficiency	1	2	2
Ability to manage peak demand during major events	0,50	1	1
Environmental performance under varying occupancy conditions	0,50	1	1

	Operational energy efficiency	Ability to manage peak demand during major events	Environmental performance under varying occupancy conditions	local weight	A*w	λ
Operational energy efficiency	0,5	0,5	0,5	0,5	1,5	3
Ability to manage peak demand during major events	0,25	0,25	0,25	0,25	0,75	3
Environmental performance under varying occupancy conditions	0,25	0,25	0,25	0,25	0,75	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.11 – In-use indicators (Energy and environmental performance in operation). Source: author's elaboration.

Indicators C3.4

	Contribution to district activation	Public and urban relevance beyond event days	Risk of underuse / white elephant exposure
Contribution to district activation	1	1	0,5
Public and urban relevance beyond event days	1,00	1	0,50
Risk of underuse / white elephant exposure	2,00	2	1,00

	Contribution to district activation	Public and urban relevance beyond event days	Risk of underuse / white elephant exposure	local weight	A*w	λ
Contribution to district activation	0,25	0,25	0,25	0,25	0,75	3
Public and urban relevance beyond event days	0,25	0,25	0,25	0,25	0,75	3
Risk of underuse / white elephant exposure	0,50	0,5	0,50	0,50	1,50	3

λ	3
CI	0
RI	0,58
CR	0
acceptable ?	yes

Table B.12 – In-use indicators (Urban, social and legacy performance). Source: author's elaboration.

The local weights reported in the indicator tables express the relative importance of each indicator within its own group. They answer a specific question: within a given sub-criterion, which indicator contributes more strongly to the evaluation? This

distinction prevents the model from treating all indicators as equivalent simply because they appear in the same table.

The global weights, reported in the table B.13, express the relevance of each indicator in relation to the overall objective of the framework. They are obtained by combining the weight of the indicator with the weights of the higher levels of the hierarchy. In this way, the model shows not only which indicators matter within their group, but which ones actually influence the final assessment most strongly.

This distinction between local and global weights is essential. An indicator may have a high local weight but a more limited impact on the final result if it belongs to a less influential branch of the hierarchy. The opposite may also occur. An indicator with moderate local relevance may acquire greater importance if it is part of a highly weighted phase, such as the in-use phase.

The consistency checks reported in the tables above, verify whether the pairwise comparisons are sufficiently coherent. AHP does not assume that judgement is perfectly consistent. It recognises that some degree of inconsistency is natural when complex criteria are compared. For this reason, the Consistency Index and Consistency Ratio are calculated for the matrices. A Consistency Ratio below the conventional threshold of 0.10 indicates that the matrix can be considered acceptable for analytical use.

Main criteria	local weight	Sub-criteria	local weight	Indicators	local weight	global weight
C1 Design and planning phase	0,25	C1.1 Functional and spatial strategy	0,38	I1	0,623	0,058
				I2	0,239	0,022
				I3	0,137	0,013
		C1.2 Technical and energy strategy	0,38	I4	0,164	0,015
				I5	0,539	0,051
				I6	0,297	0,028
		C1.3 Financial and governance setting	0,13	I7	0,297	0,009
				I8	0,164	0,005
				I9	0,539	0,017
		C1.4 Urban integration and legacy by design	0,13	I10	0,297	0,009
				I11	0,164	0,005
				I12	0,539	0,017
C2 Construction phase	0,25	C2.1 Delivery and schedule control	0,42	I13	0,539	0,057
				I14	0,297	0,031
				I15	0,164	0,017
		C2.2 Cost and procurement robustness	0,23	I16	0,400	0,023
				I17	0,400	0,023
				I18	0,200	0,011
			0,12	I19	0,297	0,009

C3 In-use phase	0,5	C2.3 Environmental performance in construction	0,23	I20	0,539	0,017
				I21	0,164	0,005
		C2.4 Construction quality and risk control	0,23	I22	0,400	0,023
				I23	0,400	0,023
				I24	0,200	0,011
		C3.1 Functional intensity and diversification	0,42	I25	0,539	0,114
				I26	0,297	0,063
				I27	0,164	0,035
		C3.2 Operational and economic sustainability	0,23	I28	0,400	0,045
				I29	0,200	0,023
				I30	0,400	0,045
		C3.3 Energy and environmental performance in operation	0,12	I31	0,500	0,031
				I32	0,250	0,015
				I33	0,250	0,015
		C3.4 Urban, social and legacy performance	0,23	I34	0,250	0,028
				I35	0,250	0,028
				I36	0,500	0,057

Table B.13 – Global weighting structure of the AHP indicators. Source: author's elaboration.

The indicator weights reported in Annex B confirm one of the central findings of the thesis: the most sensitive variables are concentrated in the post-event phase. Indicators related to annual use, event diversification, operating burden, governance continuity, revenue structure and district integration assume strong relevance because they are directly connected to the capacity of the venue to avoid under-consolidation after the Games.

Annex B should therefore be read as the numerical core of the framework. It documents the passage from conceptual hierarchy to weighted evaluation and provides the basis for the application developed in Annex C.

ANNEX C- AHP-based performance scoring of Unipol Dome and benchmarks. Source: author’s elaboration.

Annex C presents the application of the AHP framework to Unipol Dome and to the selected benchmark venues. Its function is to document how the weighted model has been used to generate a structured performance profile.

The annex includes the evaluation of Unipol Dome, Richmond Olympic Oval and London Aquatics Centre. These venues are not compared in order to produce a simple ranking. Their roles within the thesis are different. Unipol Dome is the main case study and is assessed in an ex-ante condition, since its post-Olympic life has not yet fully unfolded. Richmond and London are benchmark references whose post-event trajectories are already more mature and therefore analytically useful.

Table C.1 reports the scoring scale used for the evaluation. The scale ranges from 1 to 5, where lower values indicate weaker alignment with long-term sustainability conditions and higher values indicate stronger alignment. This scale is separate from Saaty’s 1–9 scale used in the pairwise comparison phase. The distinction matters. The 1–9 scale defines relative importance. The 1–5 scale expresses how a venue performs against the indicators identified by the model.

Tables from C.1 to C.6 report the detailed evaluation of Unipol Dome, Richmond Olympic Oval and London Aquatics Centre respectively. Each table applies the weighted indicators developed in Annex B and assigns a performance score to the venue under analysis. The weighted result allows the assessment to move beyond a purely descriptive comparison and to identify the dimensions in which each venue appears stronger or more exposed.

Unipol Dome - AHP-based scoring application				
Code	Indicator	global weight	score (1-5)	weighted score
I1	Post-event functional adaptability	0,058	4	0,234
I2	Capacity adequacy for long-term demand	0,022	3	0,067
I3	Spatial flexibility of layout	0,013	4	0,051
I4	Integration of renewable energy systems	0,015	4	0,061
I5	Energy-conscious plant concept	0,051	4	0,202
I6	Design for operational efficiency and maintainability	0,028	4	0,111

I7	Clarity of ownership and governance model	0,009	4	0,037
I8	Consistency of investment structure	0,005	3	0,015
I9	Alignment between Olympic function and long-term business model	0,017	4	0,067
I10	Accessibility and multimodal connectivity by design	0,009	4	0,037
I11	Integration with surrounding district functions	0,005	4	0,020
I12	Explicit consideration of post-event legacy in planning	0,017	4	0,067
I13	Compliance with Olympic delivery timeline	0,057	4	0,228
I14	Continuity and reliability of construction process	0,031	4	0,126
I15	Readiness for transition from construction to operation	0,017	4	0,069
I16	Cost control during delivery	0,023	2	0,045
I17	Procurement and contractor coordination effectiveness	0,023	4	0,091
I18	Resilience to schedule-cost pressure	0,011	2	0,023
I19	Use of low-carbon and lower-impact materials	0,009	4	0,036
I20	Embodied carbon mitigation measures	0,017	4	0,066
I21	Construction waste and logistics efficiency	0,005	3	0,015
I22	Construction quality assurance	0,023	4	0,091
I23	Risk management and compliance control	0,023	4	0,091
I24	Consistency between planned and delivered performance	0,011	3	0,034
I25	Annual intensity of use	0,114	3	0,342
I26	Diversity of hosted event types	0,063	4	0,252
I27	Occupancy and utilisation regularity	0,035	3	0,104
I28	Balance between operating burden and activity level	0,045	3	0,136
I29	Revenue diversification potential	0,023	4	0,091

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I30	Maintenance and operational resilience	0,045	3	0,136
I31	Operational energy efficiency	0,031	3	0,092
I32	Ability to manage peak demand during major events	0,015	4	0,061
I33	Environmental performance under varying occupancy conditions	0,015	3	0,046
I34	Contribution to district activation	0,028	3	0,085
I35	Public and urban relevance beyond event days	0,028	3	0,085
I36	Risk of underuse / white elephant exposure	0,057	3	0,170
				3,489

Table C.1 – AHP-based performance scoring of Unipol Dome. Source: author's elaboration.

Final score	Interpretation
4,00 – 5,00	Strong long-term sustainability
3,00 – 3,99	Moderate sustainability with manageable risks
2,00 – 2,99	Fragile long-term sustainability
< 2,00	High risk of underuse / weak long-term viability

phase	weighted score	share of total
design and planning	0,97	28%
construction	0,92	26%
in-use	2	46%

Table C.2 – Summarized scores of Unipol Dome. Source: author's elaboration.

The results reported in Table C.2 indicate a favourable design and strategic profile for Unipol Dome. The arena benefits from its multifunctional configuration, its position within the Milan metropolitan event market and its relationship with the wider Santa Giulia regeneration process. These conditions place it in a stronger initial position than many specialised Olympic venues historically associated with white elephant risk.

The construction-related assessment is generally positive, although it remains linked to delivery pressure, cost control and the reliability of implementation. Olympic-related construction processes are never entirely neutral. They are shaped by fixed deadlines and institutional exposure, and these factors may influence the long-term quality of the asset.

The most uncertain area is the in-use phase. Here the evaluation becomes more cautious. Regular activation, diversified programming, operating balance, governance continuity, revenue resilience, environmental performance and district integration remain variables that must be verified over time. This explains why the final assessment is positive but not conclusive.

Richmond Olympic Oval - comparative scoring application

Code	Indicator	global weight	score (1-5)	weighted score
I1	Post-event functional adaptability	0,058	5	0,292
I2	Capacity adequacy for long-term demand	0,022	4	0,090
I3	Spatial flexibility of layout	0,013	5	0,064
I4	Integration of renewable energy systems	0,015	3	0,046
I5	Energy-conscious plant concept	0,051	4	0,202
I6	Design for operational efficiency and maintainability	0,028	5	0,139
I7	Clarity of ownership and governance model	0,009	5	0,046
I8	Consistency of investment structure	0,005	5	0,026
I9	Alignment between Olympic function and long-term business model	0,017	5	0,084
I10	Accessibility and multimodal connectivity by design	0,009	4	0,037
I11	Integration with surrounding district functions	0,005	5	0,026
I12	Explicit consideration of post-event legacy in planning	0,017	5	0,084
I13	Compliance with Olympic delivery timeline	0,057	4	0,228
I14	Continuity and reliability of construction process	0,031	4	0,126
I15	Readiness for transition from construction to operation	0,017	5	0,087
I16	Cost control during delivery	0,023	4	0,091

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I17	Procurement and contractor coordination effectiveness	0,023	4	0,091
I18	Resilience to schedule-cost pressure	0,011	4	0,045
I19	Use of low-carbon and lower-impact materials	0,009	4	0,036
I20	Embodied carbon mitigation measures	0,017	4	0,066
I21	Construction waste and logistics efficiency	0,005	4	0,020
I22	Construction quality assurance	0,023	5	0,114
I23	Risk management and compliance control	0,023	4	0,091
I24	Consistency between planned and delivered performance	0,011	5	0,057
I25	Annual intensity of use	0,114	5	0,570
I26	Diversity of hosted event types	0,063	5	0,314
I27	Occupancy and utilisation regularity	0,035	5	0,173
I28	Balance between operating burden and activity level	0,045	5	0,227
I29	Revenue diversification potential	0,023	4	0,091
I30	Maintenance and operational resilience	0,045	5	0,227
I31	Operational energy efficiency	0,031	4	0,123
I32	Ability to manage peak demand during major events	0,015	4	0,061
I33	Environmental performance under varying occupancy conditions	0,015	4	0,061
I34	Contribution to district activation	0,028	5	0,142
I35	Public and urban relevance beyond event days	0,028	5	0,142
I36	Risk of underuse / white elephant exposure	0,057	5	0,284
				4,604

Table C.3 – AHP-based performance scoring of Richmond Olympic Oval. Source: author's elaboration.

phase	weighted score	share of total
desing and planning	1,14	25%

construction	1,05	23%
in-use	2,42	52%

Table C.4 – Summarized scores of Richmond Olympic Oval. Source: author's elaboration.

The benchmark evaluation has a different role. Table C.3 and C.4 shows the performance profile of Richmond Olympic Oval, which is useful because it demonstrates how a venue can consolidate a broader post-event function through adaptive reuse, community integration and continuity of use. Table C.5 and C.6 reports the evaluation of London Aquatics Centre, which is relevant because it shows the importance of planned transformation and urban absorption within a wider regeneration context. These cases are not templates for Unipol Dome. They are reference points that make the conditions of stronger legacy more legible.

London Aquatics Centre - comparative scoring application				
Code	Indicator	global weight	score (1-5)	weighted score
I1	Post-event functional adaptability	0,058	5	0,292
I2	Capacity adequacy for long-term demand	0,022	5	0,112
I3	Spatial flexibility of layout	0,013	4	0,051
I4	Integration of renewable energy systems	0,015	3	0,046
I5	Energy-conscious plant concept	0,051	4	0,202
I6	Design for operational efficiency and maintainability	0,028	4	0,111
I7	Clarity of ownership and governance model	0,009	5	0,046
I8	Consistency of investment structure	0,005	4	0,020
I9	Alignment between Olympic function and long-term business model	0,017	5	0,084
I10	Accessibility and multimodal connectivity by design	0,009	5	0,046
I11	Integration with surrounding district functions	0,005	5	0,026
I12	Explicit consideration of post-event legacy in planning	0,017	5	0,084
I13	Compliance with Olympic delivery timeline	0,057	5	0,285
I14	Continuity and reliability of construction process	0,031	5	0,157

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I15	Readiness for transition from construction to operation	0,017	5	0,087
I16	Cost control during delivery	0,023	4	0,091
I17	Procurement and contractor coordination effectiveness	0,023	4	0,091
I18	Resilience to schedule-cost pressure	0,011	4	0,045
I19	Use of low-carbon and lower-impact materials	0,009	3	0,027
I20	Embodied carbon mitigation measures	0,017	3	0,050
I21	Construction waste and logistics efficiency	0,005	3	0,015
I22	Construction quality assurance	0,023	5	0,114
I23	Risk management and compliance control	0,023	5	0,114
I24	Consistency between planned and delivered performance	0,011	5	0,057
I25	Annual intensity of use	0,114	4	0,456
I26	Diversity of hosted event types	0,063	4	0,252
I27	Occupancy and utilisation regularity	0,035	5	0,173
I28	Balance between operating burden and activity level	0,045	4	0,182
I29	Revenue diversification potential	0,023	3	0,068
I30	Maintenance and operational resilience	0,045	4	0,182
I31	Operational energy efficiency	0,031	4	0,123
I32	Ability to manage peak demand during major events	0,015	4	0,061
I33	Environmental performance under varying occupancy conditions	0,015	4	0,061
I34	Contribution to district activation	0,028	5	0,142
I35	Public and urban relevance beyond event days	0,028	5	0,142
I36	Risk of underuse / white elephant exposure	0,057	5	0,284

4,380

Table C.5 – AHP-based performance scoring of London Aquatic Center. Source: author's elaboration.

phase	weighted score	share of total
desing and planning	1,12	26%
construction	1,13	26%
in-use	2,13	49%

Table C.6 – Summarized scores of London Aquatic Center. Source: author's elaboration.

Venue	Total weighted score	Assessment class	Design subtotal	Construction subtotal	In-use subtotal
Unipol Dome	3,49	moderate-good	0,97	0,92	1,601
richmond	4,60	good-strong	1,14	1,05	2,416
london	4,38	good-strong	1,12	1,13	2,126

Table C.7 – Summarized performances of Venues. Source: author's elaboration.

Selected high-relevance indicators for comparative reading				
code	indicator	Unipol Dome	richmond	london
I1	Post-event functional adaptability	4	5	5
I2	Capacity adequacy for long-term demand	3	4	5
I3	Spatial flexibility of layout	4	5	4
I15	Readiness for transition from construction to operation	4	5	5
I25	Annual intensity of use	3	5	4

I26	Diversity of hosted event types	4	5	4
I31	Operational energy efficiency	3	4	4
I34	Contribution to district activation	3	5	5
I35	Public and urban relevance beyond event days	3	5	5
I36	Risk of underuse / white elephant exposure	3	5	5

Table C.8 – Selected indicators with higher relevance for comparative reading. Source: author’s elaboration.

The comparative synthesis reported in Table C.8 brings together the three evaluation profiles and allows a more direct reading of similarities and differences. The comparison confirms that long-term venue sustainability is rarely produced by one factor alone. It depends on alignment. Design must support use. Governance must sustain adaptation. The venue must find a market and an urban role that are proportionate to its scale.

Annex C therefore provides the applied layer of the thesis. It shows how the model moves from weights to performance assessment and how the results support the scenario-based interpretation developed later in the research.

ANNEX D- Sensitivity analysis

Annex D presents the sensitivity analysis developed to test the robustness of the AHP-based evaluation. Its purpose is to verify whether the final assessment remains broadly stable when plausible changes are introduced into the weighting structure or into selected performance assumptions.

Sensitivity analysis is necessary because the model includes judgement. Even when criteria and weights are grounded in literature, benchmark evidence and expert-informed reasoning, they remain interpretative. A credible framework should therefore be tested against alternative assumptions. If the final result changed radically after a small variation, the model would be too fragile.

Table D.1 presents the first sensitivity test, based on the variation of the main criteria weights. In this case, the relative importance of design, construction and in-use operation is modified while keeping the indicator scores unchanged. This test examines whether the overall assessment depends excessively on the initial balance assigned to the three life-cycle phases.

The results reported in Table D.1 show limited variation. The final score remains within a narrow range and the interpretative classification does not change substantially. This suggests that the model is not artificially driven by one specific configuration of the main criteria weights. The hierarchy matters, but the evaluation is not dependent on a single fragile assumption.

Main weights

Scenario	Design weight	Construction weight	In-use weight	Design subtotal	Construction subtotal	In-use subtotal	Total weighted score	Normalised score	Assessment class
base case	0,25	0,25	0,5	0,97	0,915	1,601	3,49	70%	moderate to good
balanced phase	0,33	0,33	0,34	1,28	1,208	1,089	3,58	72%	moderate to good
design led	0,35	0,20	0,45	1,36	0,732	1,441	3,53	71%	moderate to good
construction risk	0,25	0,35	0,4	0,97	1,282	1,281	3,53	71%	moderate to good
use intensive	0,20	0,20	0,6	0,78	0,732	1,921	3,43	69%	moderate to good

Table D.1 – Sensitivity analysis of the AHP assessment under alternative main criteria weighting scenarios. Source: author's elaboration.

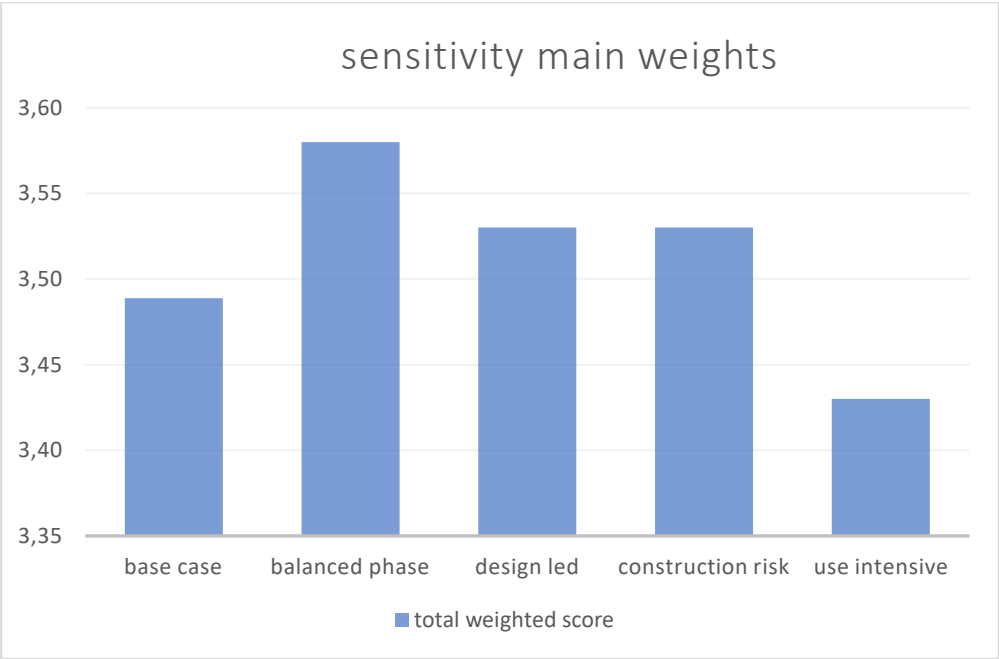


Figure D.1 – Sensitivity analysis of total weighted scores under alternative main criteria weighting scenarios. Source: author’s elaboration.

Table D.2 presents the second sensitivity test, which concerns selected critical indicators. These indicators are connected to the variables that are most likely to influence the long-term trajectory of Unipol Dome: annual intensity of use, event diversification, operational burden, district activation and white elephant exposure. Unlike the first test, this one acts directly on the substantive variables of legacy.

The results reported in Table D.2 show a wider variation. This is an important finding. The model reacts more strongly when operational and post-event indicators are modified than when the broad weights of the three life-cycle phases are rebalanced. The meaning is clear: the main uncertainty of Unipol Dome does not lie in the abstract structure of the model. It lies in the future behaviour of the venue.

Critical scores

Scenario	Changed indicators	Total weighted score	Normalised score	Assessment class
base case	-	3,49	70%	moderate to good
Demand underperformance	I25→2, I26→3, I27→2, I28→2, I29→3, I36→2	3,15	63%	moderate
Urban integration delay	I34→2, I35→2, I36→2, I11→2	3,37	67%	moderate
Operational stress	I30→2, I31→2, I32→3, I33→2, I28→2	3,34	67%	moderate
Favourable consolidation	I25→4, I26→5, I27→4, I28→4, I29→5, I30→4, I34→4, I35→4, I36→4	3,93	79%	moderate to good

Table D.2 – Sensitivity analysis of the AHP assessment under alternative critical indicator performance scenarios. Source: author's elaboration.

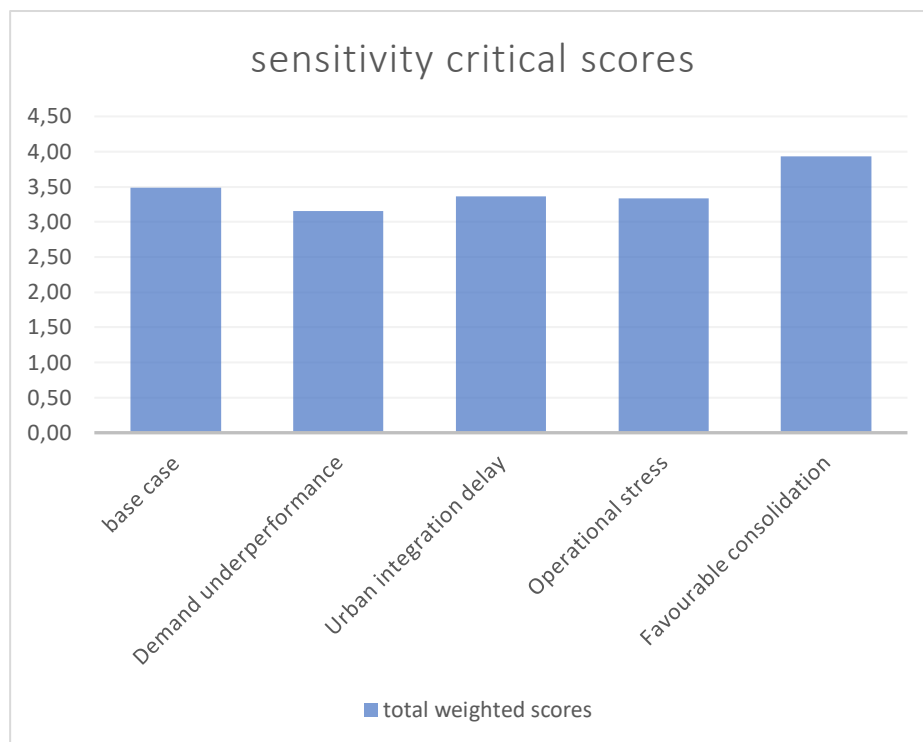


Figure D.2 – Sensitivity analysis of total weighted scores under alternative critical indicator performance scenarios. Source: author's elaboration.

summary

Test family	Min score	Max score	Range	Base score	Robustness reading
Main criteria weights	3,43	3,58	0,15	3,49	Low sensitivity: final judgement remains broadly stable across phase-weight scenarios.
Critical indicator scores	3,15	3,928	0,78	3,49	Moderate sensitivity: the final judgement reacts more visibly to changes in operational and legacy-related indicators.

Table D.3 – Summary of sensitivity analysis ranges and robustness interpretation for main criteria weights and critical indicator scores. Source: author’s elaboration.

Table D.3 summarises the overall sensitivity results and makes the comparison between the tested scenarios more readable. The synthesis confirms that the final evaluation remains relatively stable, while the in-use variables retain the strongest influence on the possible evolution of the assessment.

This result is coherent with the argument developed throughout the thesis. The long-term sustainability of the arena will be decided in the in-use phase, where post-event demand, operational balance, governance, environmental performance and district integration become observable. The sensitivity analysis confirms that these variables are the real pressure points of the case

Annex D therefore supports the transition from evaluation to strategy. It shows why the following monitoring structure cannot be generic. It must focus on the operational variables that most strongly affect the arena’s long-term trajectory.

ANNEX E- KPI framework and risk monitoring

Annex E presents the KPI framework and the risk matrix developed to support the long-term monitoring of Unipol Dome after the Milan-Cortina 2026 Games. While the previous annexes document the evaluative model, this annex translates the results into a monitoring structure.

The distinction is important. Evaluation defines the current analytical profile of the venue. Monitoring observes how that profile changes over time. Since Unipol Dome has not yet produced mature post-event data, the KPI framework and the risk matrix are necessary to understand whether the arena is moving toward a fragile, intermediate or favourable trajectory.

Table E.1 reports the KPI framework for long-term monitoring. The framework is derived from the AHP model, but it does not reproduce it entirely. The full framework is useful for structured evaluation; it would be too heavy as a practical monitoring dashboard. The KPI structure is therefore selective. It retains the variables that are dynamic, observable and strategically sensitive during the post-event phase.

The retained KPIs include use intensity and regularity, event diversification, operating burden relative to activity, operational and technical resilience, energy performance in use, revenue diversification, district integration and community accessibility. Each of these indicators corresponds to a specific question about the future behaviour of the venue.

Use intensity measures whether the arena is activated regularly rather than only through isolated high-profile events. Event diversification assesses whether the venue is building a broad portfolio or depending too heavily on one category. Operating burden evaluates whether costs remain proportionate to actual activity. Technical resilience captures the ability of the building to sustain repeated events without disruptions or excessive maintenance pressure.

Energy performance in use is included because sustainability cannot remain a design claim. It must be tested through actual operation. Revenue diversification is necessary because a narrow income structure may expose the arena even when early activity appears strong. District integration measures whether Unipol Dome becomes part of the Santa Giulia urban system or remains mainly an event-day destination.

Community accessibility introduces a social dimension, without assuming that the arena should function as a civic facility in the ordinary sense.

KPI name	Why it matters	Desired direction	Green condition	Amber condition	Red condition	Monitoring frequency
Use intensity and regularity	Measures whether the arena is repeatedly active across the year and whether its use remains regular rather than episodic.	Higher	Recurrent and relatively dense activation across the year, with a stable rhythm of use.	Moderate activity is visible, but continuity remains partial or uneven.	Use is too episodic or irregular for a venue of this scale.	Quarterly
Event diversification	Shows whether the venue benefits from a broad event portfolio or remains dependent on a narrow set of formats.	Higher	Broad and resilient event mix across multiple categories.	Partial diversification is visible, but some dependence remains.	The event base is too narrow and vulnerable.	Quarterly
Operating burden relative to activity	Assesses whether the effort required to run the arena remains proportionate to the level of use.	Lower	Operating burden remains absorbable in relation to activity level.	The burden is manageable, but pressure is emerging.	Operating effort appears structurally high relative to actual use.	Quarterly
Operational and technical resilience	Captures maintenance continuity, technical reliability and the ability of the venue to sustain repeated use without major disruption.	Higher	Operation remains stable, reliable and technically continuous.	Some interruptions or maintenance pressure are visible, but controllable.	Technical or operational fragility starts to interfere with regular use.	Quarterly
Operational energy performance	Tests whether the arena's technical and environmental ambitions translate into efficient operation under real conditions of use.	Lower	Energy performance remains well controlled relative to type and intensity of use.	Energy performance is acceptable but shows visible inefficiencies or pressure under some conditions.	Energy demand appears structurally high or poorly controlled.	Quarterly
Urban and district integration	Measures whether the arena is becoming part of the wider Santa Giulia district rather than remaining only an event-day destination.	Higher	The venue shows strong territorial embedding and relevance beyond event days.	Integration is growing, but remains incomplete.	The venue remains weakly absorbed into the district and wider urban life.	Quarterly / Annual

Revenue diversification	Measures whether income is distributed across several sources rather than concentrated in event ticketing or few formats.	Higher	Multiple revenue streams with reduced concentration risk.	Some diversification but dependence remains visible.	Revenue base too narrow or exposed.	Quarterly / Annual
Community accessibility	Tracks whether the venue maintains some accessible, local or community-oriented uses alongside commercial programming.	Higher	Regular community or accessible programming integrated into calendar.	Occasional initiatives with limited continuity.	Almost no non-commercial or community relevance.	Annual

Table E.1 – KPI framework for the long-term monitoring of Unipol Dome. Source: author's elaboration.

Table E.2 reports the risk matrix. The matrix complements the KPI framework by identifying the main pressures that may weaken the long-term trajectory of the venue. The risks considered include underutilisation, market saturation, weak district development, governance fragmentation, energy cost escalation, revenue concentration and loss of public relevance.

These risks are not isolated events. They are cumulative processes. A venue rarely becomes fragile all at once. It may begin with an irregular calendar, then show excessive dependence on one event type, then face rising operating costs, weak district activation or unclear governance responsibilities. One signal can be managed. Several signals, if persistent, may gradually move the venue toward a weaker trajectory.

Underutilisation is the most severe risk because it affects almost all other dimensions. If the arena is not activated regularly, revenue diversification becomes harder, the operating burden grows heavier, environmental justification weakens and urban integration remains limited.

Market saturation concerns the arena's position within the Milanese and regional event system. Milan is a strong market, but strength does not remove competition. The venue will need a recognisable profile and a programming strategy capable of distinguishing it from other facilities.

Weak district development is especially relevant because the arena is embedded in the Santa Giulia regeneration area. If the surrounding district remains incomplete or weakly activated, Unipol Dome may operate successfully on event days while failing to become a broader urban asset.

Governance fragmentation is less visible but dangerous. It may not produce immediate failure, but it can weaken monitoring, accountability and corrective action. Energy cost escalation and revenue concentration are operational risks that may

become more evident once the venue enters ordinary post-event operation. Loss of public relevance is subtler. A venue can be commercially active and still socially thin. The KPI framework and risk matrix should therefore be read together. Table E.1 indicates what should be observed. Table E.2 explains why those observations matter. Their combined function is not to predict success or failure, but to detect early signs of consolidation or weakness before they become structural.

Risk	Description	Probability (1-5)	Impact (1-5)	Risk score	Risk class	Mitigation logic
Underutilisation	Insufficient regular activation after the Olympic phase.	3,00	5	15	Medium	Secure a diversified annual programme and early promoter agreements.
Market saturation	Competition from other Milan and regional venues compresses demand.	4,00	4	16	High	Differentiate event formats and strengthen commercial positioning.
Weak district development	Santa Giulia develops more slowly than expected, limiting urban embedding.	2,00	4	8	Low	Coordinate venue strategy with district phasing and public-space activation.
Governance fragmentation	Responsibilities for long-term performance become blurred.	2,00	4	8	Low	Introduce annual reporting and clear KPI ownership.
Energy cost escalation	High energy prices weaken operating sustainability.	3,00	5	15	Medium	Optimise energy management, procurement and event-based energy benchmarking.
Revenue concentration	Too much income depends on few event types or partners.	3,000	4	12	Medium	Expand hospitality, sponsorship, corporate and non-event revenue streams.
Loss of public relevance	The venue remains commercially active but socially thin.	2,00	4	8	Low	Reserve part of annual programming for accessible and community-oriented uses.

Table E.2 – Risk matrix for the long-term sustainability of Unipol Dome. Source: author's elaboration.

Annex E closes the methodological sequence of the appendices. Annex A defines the hierarchy. Annex B develops the weights. Annex C applies the model. Annex D tests its robustness. Annex E turns the evaluation into a monitoring structure.

This sequence reflects the logic of the thesis. Unipol Dome should not be judged only at the moment of Olympic use. It should be observed over time, through indicators capable of showing whether temporary visibility is becoming durable legacy.

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