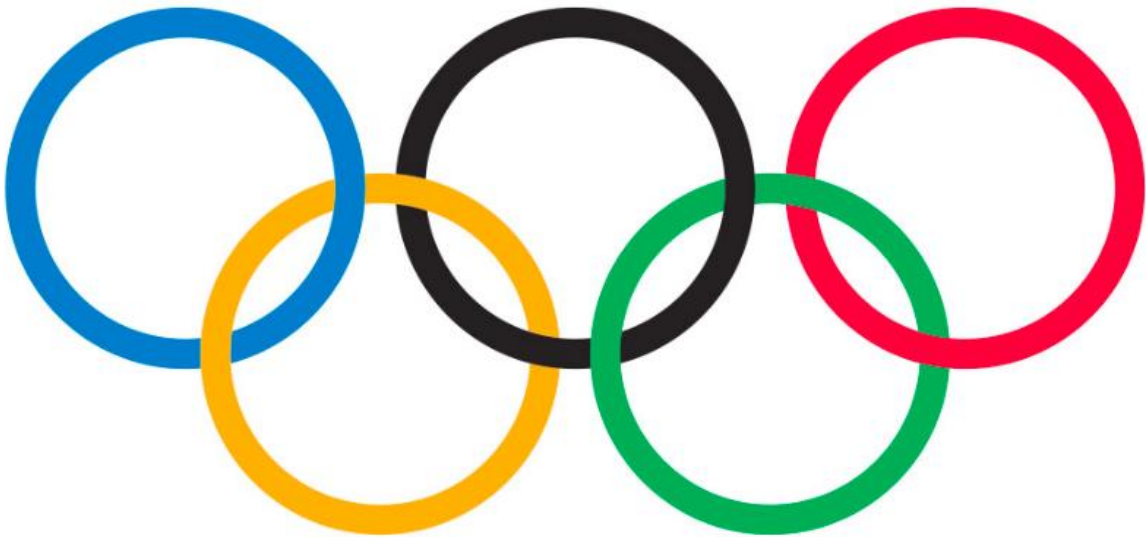


Risk Assessment on Hosting Summer Olympic Games



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Introduction and Background

The behemoth commitment to host the modern Olympics Games comes with stupendous risk management challenges. Therefore, it is unsurprising that the rhetoric of risk and risk management has become so prevalent that many cities are withdrawing its bid to host the games. Our team will conduct a detailed risk assessment by identifying the top risk factors both internal and external that adversely impact the cities that host the games before and after the games have ended.

Our assessment will primarily focus on the 2012 London and 2016 Rio Olympic Games.

The main areas of risk that need to be managed for the successful delivery of the Games are set out in Figure 1. The risks are, of course, interdependent – failure in any one area will impinge on others. Nevertheless, with an average timetable of 72 months from announcing the winning of hosting the Games, it is essential to keep the momentum up so that progress is maintained and any risk associated with the games is mitigated and control to lessen its likelihood and impact.

The bid for the Olympic Games envisioned a plan for a largely privately-funded Olympic Games, which was projected to run a surplus and be a catalyst for long-lasting commercial and residential development and infrastructure improvements. Many hosting nations believe it could leverage many existing facilities instead of constructing new venues, however historical data shows that 80% of all hosting nations construct new infrastructure to support that hosting of the games.

To mitigate certain risks associated with hosting the Olympic Games, recently Los Angeles, California and Paris, France proposed a comprehensive insurance plan similar to policies used for typical mega-infrastructure projects and mega-events. This insurance plan would have an added layer of protection for Massachusetts taxpayers against potential revenue shortfalls or cost overruns. Although insurance would not have been able to eliminate all risks, the Los Angeles proposed a detailed plan to mitigate some of the risks outside of its control.

Risk and the Olympics

The main areas of risk that need to be managed for the successful delivery of the games are:

1. Delivering the Games against an immovable deadline.
2. The need for strong governance and delivery structures given the multiplicity of organisations and groups involved in the Games.
3. The requirements for the budget to be clearly determined and effectively managed.
4. Applying effective procurement practices.
5. Planning for a lasting legacy for Olympic venues.
6. Ensuring a safe Olympic Games for athletes and fans from around the world.

From a host city perspective, this report focuses on the risk events associated with a Host Nation hosting the Games. We attempt to analyze the financial risk and sensitivity of the overall budget to potential increases and decreases in the revenues and cost. Ticket sale revenues in prior Summer Olympic Games since 1996 have all generated more revenue than initially estimated. However, ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games.

Cost overruns refer to outcomes where the actual cost of constructing Olympic Games venues or other capital projects and Olympic Games operations exceeds the spending specified in the bid. Some cost overruns may be attributed to the difficulty of accurately forecasting costs and revenues nearly a decade in the future. Other overruns may be anticipated, such as increases in local demand for construction workers leading to higher construction industry wages. Overruns can also occur because of changes in scope. As the Olympic Games approach, organizers may realize that some proposed venues may be too small, or may not contain adequate features for either the Olympic Games or for their intended use after the Olympic Games.

Research indicates that between 1950 and 2012, the Summer Olympic Games experience average cost overruns of 179 percent. London's 2004 bid for the 2012 Summer Games estimated the total cost at \$18.3 billion, of which \$5.5 billion was to be funded by the U.K. government. When the dust settled the U.K. Government had spent an estimated \$14 billion. These cost overruns were due to underestimates of construction cost, the lost of private developer funding and poor planning for security needs.

Security for the Olympic Games is both costly and a source of great risk and uncertainty. Previous incidents at prior Games (1972 Munich and 1996 Atlanta Games) as well as 9/11 and the 2013 Boston

Marathon bombing have continued to ratchet up security concerns. The Summer Olympic Games in London had total security costs of \$1.4 billion.

Figure 1: Risk Events

☐ Enable Multi-select

Unique ID	Events
[13]	Construction delays
[10]	Cost Overrun
[05]	Criminal Activity
[07]	Cyber Security Attacks: Infrastructure
[08]	Cyber Security Attacks: PII Data Confidentiality
[11]	Displacement of Local
[02]	Epidemic Outbreak
[14]	Meeting delivery of the Games against an immovable deadline
[04]	Political Protest
[09]	Revenue Shortfall
[12]	Site preparations and infrastructure
[03]	Terrorist Attack
[06]	Transportation Attacks
[15]	Unused Olympic Venues post Games
[16]	Venue Construction

15 Risk events were identified during the risk analysis would represent a loss to the host nation/city hosting the Summer Olympic Games:

Epidemic Outbreak: Notable health risk in Rio include mosquito-borne viruses as well as communicable diseases. Because of the masses of people in attendance at the Games, common contagious diseases also pose a significant risk: Zika Virus and H1N1 swine flu.

Meeting the delivery of the Games against an immovable date: The Olympic Games is a two week event, so the organizations involved in delivering the Games have a fixed deadline. The Olympic program is comprised of a series of individual but interdependent projects. The set deadline for the Games means any delay to elements of the delivery program risks putting pressure on cost and/or quality.

The hosting city has seven years from being awarded the bid to host the Games to acquiring and preparing the land, secure planning permissions, design work and procurement; 4 years to build the venues and infrastructure; and one year to fit out the venues for the Games and stage test events.

Political Protest: One of the most uncertain risk facing the Games is that of mass social unrest, which typically begin to occur during the construction phase. Political angst towards the entire political establishment and protest against the Games.

Unused Olympic Venues: Outlining the legacy proposals for the five new sports venues that will remain on the Olympic Park site following the Games, including the main Stadium and the Aquatics Center. Developing a robust business plan for the Olympic venues with a clear focus on operation cost to avoid the risk of facilities being under used or unaffordable after the Games.

Transportation/Terrorist Attacks: ISIS/Al Qaeda

Displacement of Locals: Approximately 20,000 families relocated from the Vila Autodromo and Barra da Tijuca for the Rio Games. Displacement of families to construct Olympic Game venues.

Cyber Security Attacks:

Construction Delays:

Site Preparation and Infrastructure: High number of interfaces and complexity; new bridges, roads, sewers, utilities connecting to the venues

Revenue Shortfall: The Organizing Committee for the Olympic Games' (OCOG) project revenues to come from four major sources: ticket sales, International Olympic Committee (IOC) contributed broadcast rights and global sponsorship revenues; domestic sponsorship, and licensing and similar sources.

IOC contributed approximately \$1.5B from broadcast rights and global Olympic sponsors such as Coca-Cola, McDonald's and Visa. Ticket sales revenues in prior Summer Olympic Games since 1996 have all generated more revenue than initially estimated. However, ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games.

Criminal Activity: Robbery, Murder, Sexual Assault/Rape, Card cloning at ATM machines

Cost Overruns: Cost overruns refer to outcomes where the actual cost of constructing Olympic Games venues or other capital projects and Olympic Games operations exceeds the spending specified in the bid.

Figure 2: Sources

The screenshot shows a web-based interface for identifying sources of risk. At the top, there are two checkboxes: "Select all but lowest level" and "Select the lowest level". Below this is a tree view under the heading "Sources". The tree is organized into four main categories, each with a blue header and a dropdown arrow:

- Finance/Budgeting**
 - ☐ Increases in local demand for construction workers leading to higher construction industry wages.
 - ☐ Cost estimates and revenue streams are calculated years in advance to a host nation/city submits its bid
 - ☐ Ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games
 - ☐ Weakened negotiation position
 - ☐ Increased levels of inflation in the construction industry resulting from unplanned surges in demand
- Human Factor**
 - ☐ Inadequate construction workers
 - ☐ Political corruption
 - ☐ Bribes
 - ☐ Common Contagious diseases
- Infrastructure**
 - ☐ Lack of key legacy plan benefits that are realistic in scope and timing with the Games
 - ☐ Construction of Olympic Village
 - ☐ Construction of media facilities
 - ☐ Construction of Olympic Park
 - ☐ Construction of Aquatic Center
- Terrorism**
 - ☐ Terrorist Attack on Olympic Venues
 - ☐ ISIS
 - ☐ Al Qaeda
 - ☐ Cyber Attack Olympic Committee IT Infrastructure

Each item in the list has a small circular icon to its left, containing a number (e.g., 1, 2, 3).

According to Risk Management methodology, sources are threats/hazards that cause the likelihood of a risk event to occur. For this risk assessment, our group categorized all sources as threats.

Source Description:

Financial Budgeting: Increases in local demand for construction workers leading to higher construction industry wages. Cost estimates and revenue streams calculated years in advance to a host nation/city submitting its bid. Ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games. Weakened negotiating position. Increased levels of inflation in the construction industry resulting from unplanned surges in demand.

Human Factors: Inadequate construction workers. Political corruption. Bribes and Common Contagious Diseases.

Infrastructure: Lack of a key legacy plan benefits that are realistic in scope and timing with the Games for venues post Games. Construction of venues.

Terrorism: ISIS/AI Qaeda; Cyber Attacks

Once events and sources were identified, the Riskion model allows the user to map sources to events. Multiple sources may contribute to an event and an event need not have a contributing source.

Events	Sources															
	Finance/Budgeting					Human Factor				Infrastructure					Terrorism	
	Increase	Cost est.	Ticket sa	Weaken	Increase	Inadequa	Political	Bribe	Common	Lack of k	Construct	Construct	Construct	Construct	Terrorist	ISIS
Construction delays	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cost Overrun	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criminal Activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cyber Security Attacks: Infrastructure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Cyber Security Attacks: PII Data Confidentiality	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Displacement of Local	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Epidemic Outbreak	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meeting delivery of the Games against an immovable deadline	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Political Protest	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Revenue Shortfall	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Site preparations and infrastructure	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Terrorist Attack	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Transportation Attacks	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Unused Olympic Venues post Games	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Venue Construction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Figure 3: Mapping Sources to Events

Measuring Risk and Likelihood

Figure 4: Risk Evaluation: Managing Risk and Likelihood

<input type="checkbox"/>	Email Address	Participant Name	Permission	Has Data?	Disabled?	Action
<input type="checkbox"/>	dcopeland@gwu.edu	D'antione Copeland	Project Manager	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	goe@gwu.edu	Government Olympic Executive	Evaluator	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	hosassg@gwu.edu	Home Office Safety and Security Strategic Steering Group	Evaluator	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	hoda@gwu.edu	Hosting City Development Agency	Evaluator	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	ibrahim1985@gwu.edu	ibrahim sheriff	Project Manager	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	ioc@gwu.edu	International Olympic Committee	Evaluator	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	nstavrakakis@gwu.edu	Nicholas Stavrakakis	Project Manager	No	<input type="checkbox"/>	  
<input type="checkbox"/>	ocog@gwu.edu	Organizing Committee of the Olympic Games and Paralympic Games	Evaluator	Yes	<input type="checkbox"/>	  
<input type="checkbox"/>	forman@gwu.edu	Professor Forman	Project Manager	No	<input type="checkbox"/>	  

Government Olympic Executive: The team responsible for handling Olympic matters within the Department for Culture, Media and Sport.

Home Office Safety and Security Strategic Steering Group: Takes a strategic overview of the work of the stakeholders in relation to the Olympic program as a whole. Responsible for ensuring that the Olympic Board is kept informed and regularly briefed on all relevant matters.

Hosting City Development Agency: Will prepare the Olympic Park site, build the new venues and provide for their legacy use, and deliver the Olympic Village, media facilities, and infrastructure for the Games.

International Olympic Committee: International non-governmental organization and creator of the Olympic Movement. Its primary responsibility is to supervise the organization of the Summer and Winter Olympic Games.

Organizing Committee of the Olympic Games and Paralympic Games: Responsible for the operational and staging aspects of the Games.

Figure 5 Measurement Method and Ratio Scale:

Scale name: Terrorist Threat

Description:

☐ Use as default

Edit

Intensity Name	Likelihood	Description	
UNLIKELY	0.006666		✕
RARE	0.023333		✕
POSSIBLE	0.205555		✕
LIKELY	0.366668		✕
ALMOST CERTAIN	0.533333		✕
DEFINITELY CERTAIN	0.7500		✕

Scale name: FINANCE/BUDGETTING SCALE

Description:

☐ Use as default

Edit

Intensity Name	Likelihood	Description	
VERY HIGH	0.9000		✕
HIGH	0.6000		✕
MODERATE	0.4000		✕
LOW	0.1000		✕
VERY LOW	0.0500		✕

Scale name:
☐ Use as default

Description:

Edit

Intensity Name	Likelihood	Description	
VIRTUALLY CERTAIN	0.8000		✕
VERY LIKELY	0.55714		✕
LIKELY	0.41428		✕
ABOUT AS LIKELY AS NOT	0.171428		✕
UNLIKELY	0.0585714		✕
VERY UNLIKELY	0.0285714		✕
EXCEPTIONALLY UNLIKELY	0.0042857		✕

Scale name:
☐ Use as default

Description:

Edit

Intensity Name	Likelihood	Description	
UNLIKELY	0.0066666		✕
RARE	0.0233333		✕
POSSIBLE	0.2055555		✕
LIKELY	0.3666668		✕
ALMOST CERTAIN	0.5333333		✕
DEFINITELY CERTAIN	0.7500		✕

Historical data from past Olympic Games was analyzed and used to determine the ratio scale as the risk measurement method to evaluate the likelihood of the risk events and sources. Figures 5 show which measurement type and scale used for sources and events.

Overall Risk Results

The initial risk results in the Riskion model show that the “Cost overrun” is the event that results in the greatest risk at 14.86%. This not surprising based on historical data, that reports that from 1960 to 2012 the Olympic Games have an estimated cost overrun of 179%. The second event was “Revenue Shortfall” at 11.4%. As stated earlier in the report, However, ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games. Sponsorship revenue shortfalls may arise if the committee is unable to secure sponsors and/or if the sponsors do not fulfill their financial obligations. However, it was insightful that “Unused Olympic Venues” did not have a higher percentage in the risk simulation. Based on our analysis and comparing historical data from past Games, we believe our measurements for the risk events was not measured precisely as we anticipated

this event to have a high risk. When we ran the model through 1,000 simulations and had a total risk of 863.79% with an average loss of 91.70. When we normalized the events likelihood we received total risk of 63.07%.

Figure 6: Overall Likelihoods, Impacts and Risk Simulation

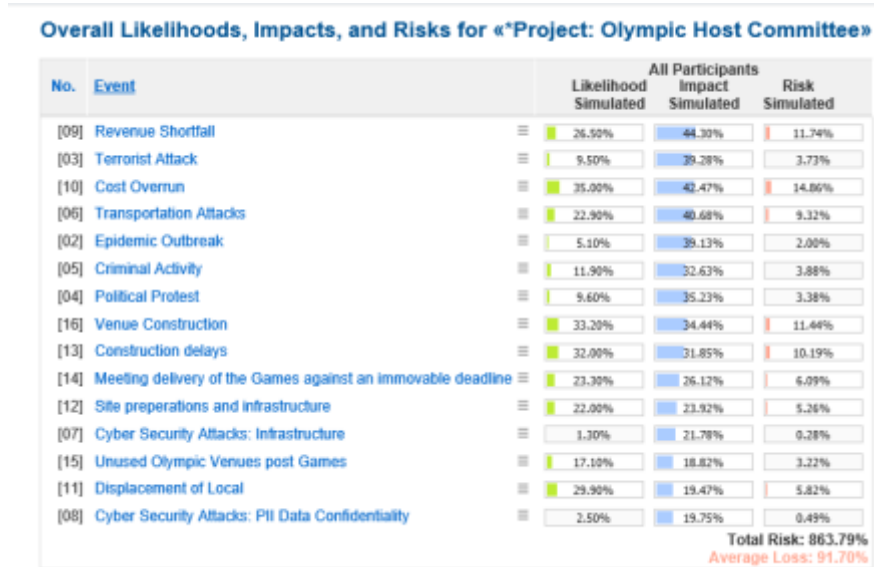


Figure 7: Overall Likelihoods, Impacts and Risk Simulation (Normalized)

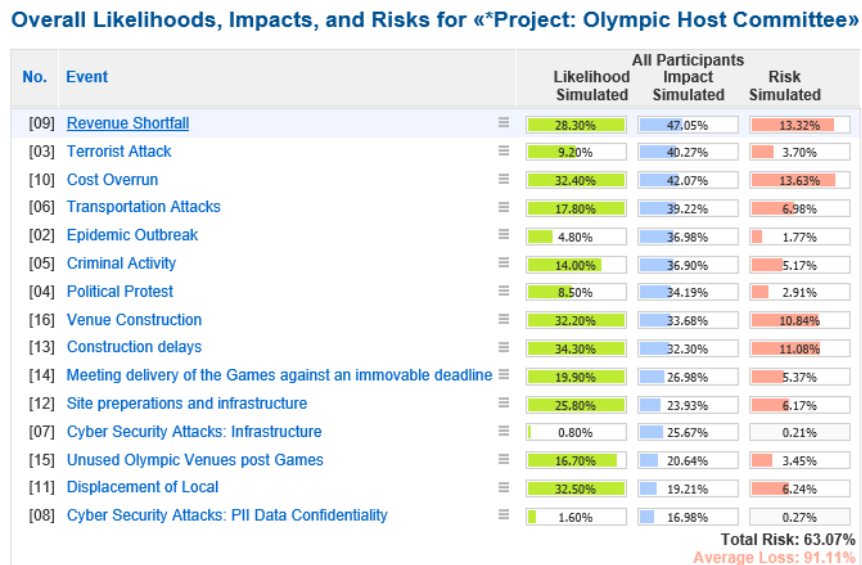


Figure 8: Risk Map Impact vs. Likelihood

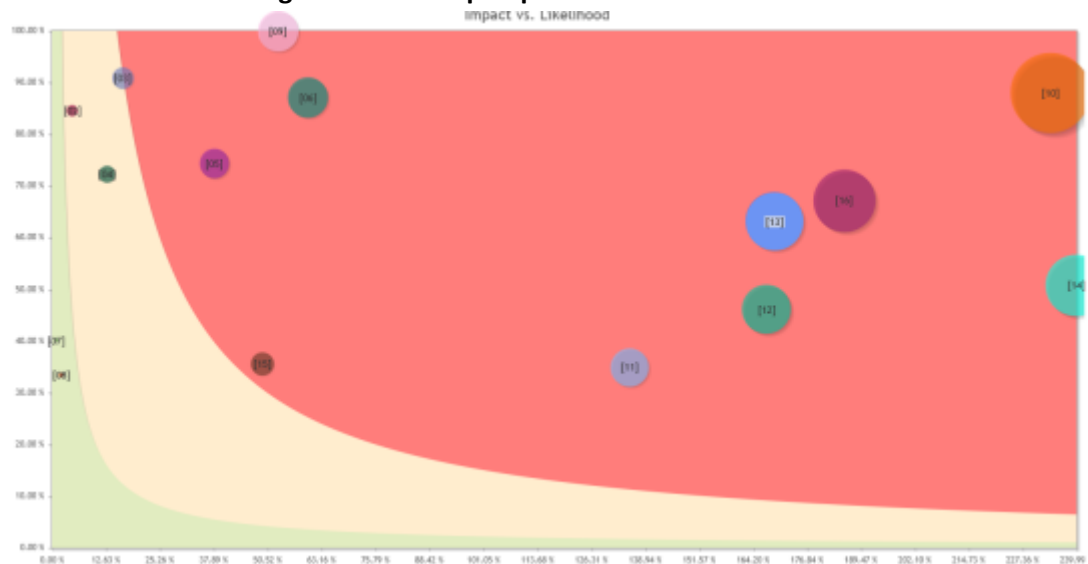
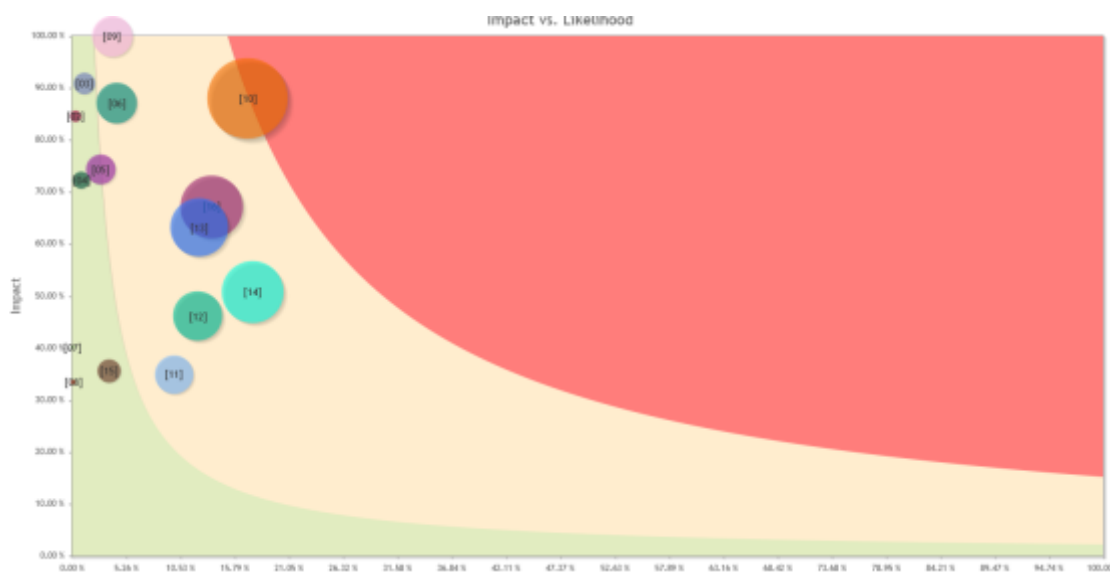


Figure 9: Risk Map Impact vs. Likelihood (Normalized)



Controls

Controls were established to be applied to sources and threats in Riskion model under the Bowtie diagram in Riskion. Controls were developed to reduce the overall inherent risk to an acceptable level of residual risk for the host nations.

Figure 10: Controls for Threats Likelihoods

Controls for Threat Likelihoods

Control Name	Sources											
	Financial/Budgeting					Human Factor				Infrastructure		
	Increases in local demand for construction workers leading to higher construction industry wages.	Cost estimates and revenue streams are calculated years in advance to a host nation/city submits its bid	Ticket sales can be negatively impacted by safety and security concerns or by politically-motivated boycotts of the Olympic Games	Weakened negotiation position	Increased levels of inflation in the construction industry resulting from unplanned surges in demand	Inadequate construction workers	Political corruption	Bribe	Common Contagious diseases	Lack of key legacy plan benefits that are realistic in scope and timing with the Games	Construction of Olympic Village	Construction of media facilities
1. Making sure the timetable for constructing and testing the venues and infrastructure is adhered to, thereby avoiding the pressures on cost and quality that could come from delays giving rise to	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
2. Maintaining a clear focus on the need for timely decision making individually and collectively on a programme where there are multiple stakeholders and interests												

Control Descriptions:

1. Making sure the timetable for infrastructure construction and testing is adhered to, therefore avoiding the pressures on cost and quality that could come from cost delays..
2. Maintaining a clear focus on the need for timely decision making individually and collectively on a programme where there are multiple stakeholders and interests
3. Monitoring the performance of the Olympic Projects Review Group in facilitating timely decision making on significant projects.
4. Setting a budget for the Games and making clear how this will be funded.
5. Being clear how the cash flow needs of the Olympic Delivery Authority will be met.
6. Securing Organizing Committee of the Olympic Games income, including turning sponsorship pledges into cash.
7. Achieve a strategy to award contracts in an open and fair way, and applying best practices including that set out in the procurement policy.
8. Developing robust business plans for the Olympic venues with a clear focus on whole-life costs, to avoid the risk of facilities being under-used or unaffordable after the Games.
9. Agreeing who will be responsible for each facility during the transition phase after the Games, who will cover conversion and ongoing running costs, and who will own the assets in their legacy form.
10. Propose a comprehensive insurance plan to add a layer of protection for the host city taxpayers against potential revenue shortfalls or cost overruns.
11. Designate the Olympics as National Special Security Event to establish security measures provided by the Federal government
12. Law Enforcement Training for large-scale events equipped to deal with potential terrorist threats.
13. Increase security check-points throughout the Olympic Games.

14. Increase video camera surveillance.
15. Focus emphasis on hygiene and handwashing/hand sanitizing controls to mitigate the risk of communicable disease
16. Certain hotels may have water filtration systems, but bottled water should otherwise be used. Street food should also generally not be consumed.
17. Use DEET-based insect repellent to combat the spread of mosquito-borne viruses i.e Zika
18. Identify all remote users, accounts and associated credentials. Be sure to include SSH keys, hard-coded credentials and passwords to get visibility into who is accessing the Olympics critical systems
19. Minimize direct connection to critical assets. Isolating all sessions originating outside of the Olympic Games domain and from unmanaged devices minimizes direct connections to any critical assets and keeps credentials shielded from unauthorized users.
20. Create transparency and openness in Olympic spending.
21. Recommend the desirability of eliminating as many needless regulations while safeguarding the essential regulatory functions of the Olympic Committee.
22. Set competitive compensation rates for workers in the industry and utilizing technological advancements to reduce the physical strain that construction projects usually have on workers.

Figure 11: Likelihood, Impacts, and Risk (With Controls)

Overall Likelihoods, Impacts, and Risks (With Controls) for «*Project: Olympic Host Committee»

No.	Event		All Participants		
			Likelihood Simulated	Impact, \$ Simulated	Risk, \$ Simulated
[09]	Revenue Shortfall	≡	<div><div></div>18.80%</div>	5,205.44	978.62
[03]	Terrorist Attack	≡	<div><div></div>0.00%</div>	0	0
[10]	Cost Overrun	≡	<div><div></div>34.80%</div>	4,931.92	1,716.31
[06]	Transportation Attacks	≡	<div><div></div>12.20%</div>	4,502.88	549.35
[02]	Epidemic Outbreak	≡	<div><div></div>1.90%</div>	4,802.51	91.25
[05]	Criminal Activity	≡	<div><div></div>5.30%</div>	4,425.01	234.53
[04]	Political Protest	≡	<div><div></div>3.60%</div>	4,220.92	151.95
[16]	Venue Construction	≡	<div><div></div>24.20%</div>	3,804.24	920.63
[13]	Construction delays	≡	<div><div></div>32.10%</div>	3,691.60	1,185
[14]	Meeting delivery of the Games against an immovable deadline	≡	<div><div></div>18.80%</div>	3,349.12	629.63
[12]	Site preparations and infrastructure	≡	<div><div></div>21.70%</div>	2,723.29	590.95
[07]	Cyber Security Attacks: Infrastructure	≡	<div><div></div>0.00%</div>	0	0
[15]	Unused Olympic Venues post Games	≡	<div><div></div>10.30%</div>	2,203.49	226.96
[11]	Displacement of Local	≡	<div><div></div>24.10%</div>	2,117.83	510.40
[08]	Cyber Security Attacks: PII Data Confidentiality	≡	<div><div></div>0.10%</div>	1,327.49	1.33
			Total Residual Risk: \$25,848.19		
			Average Loss: \$7,786.91		
			Total Risk Reduction: \$60,530.39		
			Cost of Selected Controls: \$99,200		

Riskion Model shows a total risk reduction of \$25,848.19 with a total potential risk reduction of \$60,530.39. This chart also shows two characteristics: the low the likelihood of our events, the low the impact, and the high the impact, the low the likelihood of the event and this rarely occurs. Therefore there should be other contingency controls in place should incase they occur.

Figure 12: Risk Register

ID	Event Name	Likelihood	Impact	Risk	Likelihood with controls	Impact with controls	Risk with controls
1	Construction delays	169.29	63.1	106.82	55.8	63.1	35.21
2	Cost Overrun	233.91	87.93	205.69	72.9	87.93	64.1
3	Criminal Activity	38.04	74.25	28.25	6.37	74.25	4.73
4	Cyber Security Attacks: Infrastructure	0.99	40.07	0.4	0.07	40.07	0.03
5	Cyber Security Attacks: PII Data Confidentiality	2.22	33.4	0.74	0.15	33.4	0.05
6	Displacement of Local	135.33	34.89	47.22	40.33	34.89	14.07
7	Epidemic Outbreak	4.88	84.53	4.13	1.48	84.53	1.25
8	Meeting delivery of the Games against an immovable deadline	239.99	50.71	121.71	69.32	50.71	35.16
9	Political Protest	12.9	72.23	9.32	4.36	72.23	3.15
10	Revenue Shortfall	52.93	100	52.93	25.07	100	25.07
11	Site preparations and infrastructure	167.49	46.08	77.19	52.48	46.08	24.19
12	Terrorist Attack	16.56	90.81	15.03	0.29	90.81	0.26
13	Transportation Attacks	60.02	86.99	52.22	14.89	86.99	12.96
14	Unused Olympic Venues post Games	49.34	35.52	17.53	11.99	35.52	4.26
15	Venue Construction	185.55	67.16	124.62	50.64	67.16	34.01

The Riskion Model with the controls reduced the likelihood and impact of each risk event. **See Figure 12.**

Scenarios:

We analyzed and additional scenario to reduce the risk of hosting the Summer Olympic Games in the model. We attempted to provide a lower cost estimate range when applying cost per control to each source. Estimates were conducted to determine the effectiveness of the total risk reduction when each control is applied/implemented.

Scenario 2 the Risk with selected controls is \$26,163.79 with a total risk reduction of \$7,007.57.

Figure 13: Scenario 2

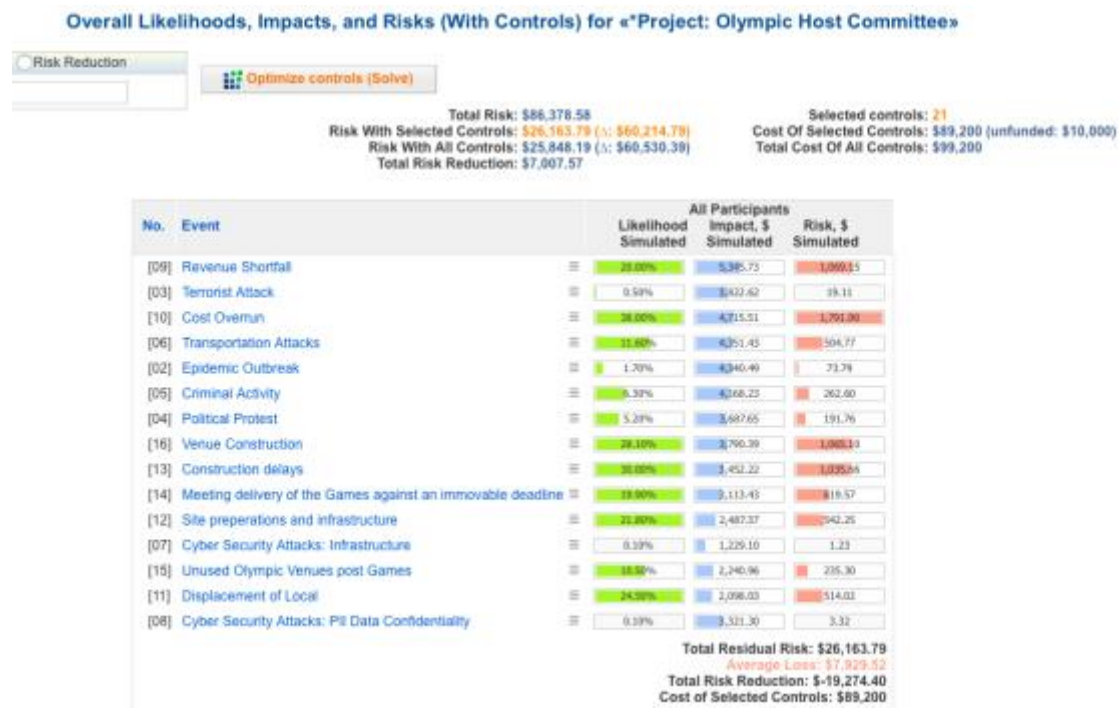
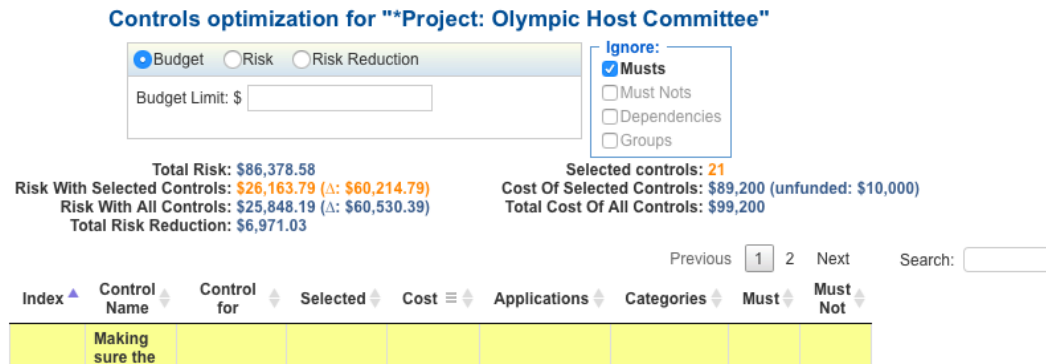


Figure 14: Controls Optimization



Conclusion:

Since the dawn of the Summer Olympic Games, risk has been influential both in governance of the Olympic movement across the various functions ranging from operation, infrastructure, public safety and health. This is observed in increased oversight of Olympic bids and the decrease in the number of potential cities submitting bids for the Summer Games. The task of governing the Summer Olympics now occurs in a time in which nations are increasingly organized in response to risks, risk control, risk treatment, risk avoidance and where uncertainties, threats, hazards and vulnerabilities are said to be a product of hosting the modern games. We believe with the controls used in the Riskion Model, nations can reduce the loss of uncertainty and reduce the overall risk of hosting the Summer Olympic Games.

As the Summer Olympic Games have grown in size and global profile since its inception, and the stakes involved have become ever higher, the potential impact of risk events, hazards and threats have severely intensified. Despite a comprehensive risk management strategy for the Summer Olympic Games, these controls, systems, and technologies cannot provide any guarantee that the Games will pass without serious incident – just as security plans prepared for international terrorism for the London 2012 and Atlanta 1996 Olympics failed to prevent an attack and cost over run by 179% for the Rio and London Games.