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A FEASIBILITY ANALYSIS MODEL FOR CONSTRUCTION OF SOCCER STADIUMS

A Thesis for the degree of

Masters of Science in Construction Engineering

Submitted By

Mohamed Zakaria Serageldin

Adviser: Dr. Khaled Nassar, Associate Professor and Associate Chair

Construction Engineering Department

The American University in Cairo

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Abbreviations

Terms	Meaning
Az1	Area of Zone 1
Lp	Length of Pitch
Wp	Width of Pitch
C	The C value
D	The Horizontal Distance from the Eye to the Point of Focus
N	The seating step height
R	The Vertical Height Between the Eye and The Point of Focus
T	The Seating Row Depth
Az2	Area of Zone 2
Sc	Stadium Capacity
Az3	Area of Zone 3
Az4	Area of Zone 4
Az5	Area of Zone 5
Dt	Stadium Total Depth Per Side
S1	Step 1
S3	Step 3
V	Stadium Coverage %
Dc	Coverage Depth which is equal to 4
VIP	The Revenue from the VIP Section
F	Factor Achieved
Tp	Ticket Price per normal ticket
G	Games Numbers played per year
Pv	Percentage of VIP seat of the total Capacity of the Stadium
DR	Discounting Rate
T	Time in the historical data
T	The time now
B	Big Mac Index
Bus	USA Big Mac Index
Bc	Chosen Country Big Mac Index
Fx	Forex Rate
X	Cost with regarding to Egyptian Market
FXc	Cost after Changing Currency to the Chosen Country
Beg	Big Mac index for Egypt
Com	Commercial Area
IRR	Internal Rate of Return
NPV	Net Present Value
Y	Current Data for the country gathered from the Revenue Excel Sheet
Z1	Revenue in Country of Y
Z2	Revenue in Chosen Country
By	Big Mac Index of Country of Y

Abstract

This current research aims to study the different stadiums worldwide and to analyze the different aspects controlling them in terms of planning, design and construction. In this regard, there have been radical changes in the stadium projects approach over the last 30 years. In the past, soccer stadiums used to be consisted of only a pitch and a seating area for the fans. However, over the last 30 years, an evolution started to take place in utilizing stadiums as economically beneficial projects. Currently, stadiums have all safety requirements and incorporate the latest technological advances in order to achieve maximum efficiency.

Furthermore, studying stadiums from different continents concentrates on the positive and negative aspects of these stadiums including different stadiums worldwide. That is an attempt to reach a viable solution to develop successful stadiums in terms of planning, design and construction. Therefore, the main goal of this study is finding a way to have a safe stadium that can generate profits to its owner plus the prospect of finding different funding options that could be used effectively.

In this study, the analysis will focus on cost, safety and profitability of each stadium project. Then, we will begin to implement our own created model for a new stadium to be built in Egypt, or any other country worldwide using the Big Mac Index. We will take into consideration the whole process of establishing a new successful soccer stadium project, starting by setting a vision, planning, design and then construction.

Chapter 1: Introduction

1. Introduction

Over the last few years, the importance of the stadiums' infrastructures has increased significantly. Thus, a great infrastructure can shape towns and cities more than any other infrastructure in history. In that retrospect, technologically advanced stadiums have become an essential ingredient of the urban mixture that binds cities together and generates significant and diverse revenues.

While the infrastructure of stadiums can be expensive, it can equally generate substantial revenues out of different aspects, such as the naming rights, sponsorship, club seating and suites, etc. In the 21st century, the global financial power of sports has increased in general. That increase made sports become the world's first global cultural activity" (Sartori, A Blueprint for Successful Stadium Development, 2013).

In the past 150 years, sport has been systematized. In the meantime, there has been a dramatic operation of urbanization coupled with populations moving from the country to the city. In the light of this social transformation, there has been a considerable increase in the popularity of sport, which can be seen as the result of this new urban society.

Through the evolution of marketing nowadays, stadiums are becoming a main component in the marketing of towns and even countries. Furthermore, the stadiums have evolved into an infrastructure form with all of the components needed to manage an independent city life including commercial, residential, retail and recreational components. Therefore, all of these components work together, along with other services and the required transportation infrastructure in order to make these cities' stadiums flourish.

2. Problem Statement

When considering the development of a new stadium or a major reconstruction, understanding the logical process of the development from the start to the end is crucial to a successful realization of the project. Ideally, the process should allow for the varied requirements of the stakeholders to be factored into the development from the very beginning. That is to say, moving forward without such a process can leave the stadium owners with several problems during the development stage, especially when the facility becomes operational. Numerous project developers have been guilty of not selecting the right site and not considering or exploring the local market. The list goes on to building too large stadium, not having sufficient premium seating or even hospitality and retail facilities. All these mistakes deprive project developers of revenue earning opportunities.

Moreover, soccer stadiums have their own problems despite their huge public profiles. Owners and operators are very aware of the shortcomings of past generations of stadiums; how they have sometimes been difficult to manage without a huge and expensive workforce, and how they have been limited in their flexibility.

More recently, many of these issues have been resolved worldwide, but there are still problems in many other countries as many stadiums worldwide are facing the problem of being non-profitable projects and not getting the needed revenues that cover the huge costs generated by the development from the beginning.

As in some stadiums sources of revenues are limited and mainly are based only on 2 aspects (ticketing and lease of stadiums per game), there are more items and sources that can help to increase the revenues, and therefore make a better cost efficiency for the development of soccer stadiums.

3. Methodology

Through this study, a generic financial model containing all parameters of a stadium will be created to maximize the cost benefit of building a stadium. This model will also act as a guide for investors, land owners and the government in order to evaluate the profitability of the coming stadium projects. This will help to minimize and eliminate the annual stadium losses in Egypt or any other country as much as possible, in order to avoid cases like the Cairo International Stadium which reported 38 Million Egyptian Pounds of losses a year. The following points will be taken into consideration:

1. A literature review will be provided, discussing the construction and financial parameters for different stadiums worldwide, and analyzing the ways of planning procedures and funding them.
2. Illustrating constructability of stadiums and what should the master plan look like for zoning and circulation.
3. A detailed generic financial model will be created according to the different parameters that can facilitate and minimize the risk factor for initiating the stadium projects worldwide and specifically in Egypt.
4. Several trials will be done on the model through verification and parametric analysis on different cases.
5. The model results will be analyzed, getting a valid beneficial point out of them that relates to the stadium's construction industry.
6. A final conclusion will be done, based on the model results and the literature

Chapter 2: Literature Review

1. Introduction

The literature review on the feasibility analysis of sports facilities is very limited and scarce. What is more to consider is that the feasibility analysis of construction of stadiums is extremely rare. However, in this literature review we will review some of the limited research works that were done previously by other researchers that deal with various topics related to sports construction in general. Specifically, the research areas in the field can be divided into four main topics. They can be simple broken down to: financing of stadiums; cost impact of stadiums on the community; construction process and finally shedding a light on "The International Association of Sports Economists". In this section we will review each of these topics.

2. Financing of Stadiums

According to “Financing professional sports facilities “(Baade, 2011) a research was done on analyzing magnitude and ways of public funding for professional sports facilities. This of course will maximize the benefits of building stadiums and getting high revenues. In the last 30 years, stadiums conceptualization began to differ from being a traditional stadium consisting of a pitch and bowl terracing to a more developed stadium with all the amenities and facilities. The stadiums started having commercial and administrative areas and hotels to increase the profits “shadow of stadiums’’ (Pransky, 2013).

Nowadays, stadiums are considered like self-financing subsidies that range from the tickets revenues, the commercial areas, sales taxes, parking fees, etc. according to “Should Cities Pay for Sports Facilities” (Zaretsky, 2001). Based on several researches there are two ways to finance the construction of stadiums: One of these ways is public financing

A- Public Financing

Based on several researches “Public funding of sports stadiums’’ (Wilhelm, 2008) and “Should the Federal Government Be Funding Private Sports Stadiums’’ (Anzilotti, 2016) , governments nowadays help a lot in the construction of stadiums. First of all, governments often donate the land for the construction. Governments can also design certain tax incentives to benefit the developers of the stadiums. In certain states, the funding options includes hotel taxes, sales taxes, car rental taxes, and money collected from selling luxury seating and rights to purchasing season tickets according to “New stadiums: prices and outrage, escalate’’ (SANDOMIR, 2008). The financing of the stadiums can come in different forms of financing like tax exempt metropolitan bonds, money installments, operating cost subsidies and infrastructure improvements, according to “Tax-exempt Municipal Bonds’’ (Tax-Exempt Municipal Bonds, 2016)

Also, according to what was mentioned by some economists ‘’Public funding of sports stadiums’’ (wilhelm, 2008) that taxpaying fans have took care of everything for a really long time. State governments and locals regularly hand over to sports group owners money, impose sponsorships, or expense exclusions to help renovate or build new stadiums. These understandings scarcely yield any positive advantage to citizens or fans. There's practically zero monetary advantage as citizens don't get rebates or sensible ticket and concession costs. New games stadiums can be an incredible thing for fans. We realize that while they are not perfect, open assets can be a major help to these tasks. We simply need the fans and citizens to get a reasonable profit for their cash. According to “what economists think about public financing for sports stadiums” (Cockrell, What economists think about public financing for sports stadiums, n.d.)

- Discounts for public servants like military, teachers, and nurses
- Low-income fan seating options
- A pledge the team will not leave its local community for at least 20 years
- Free use for public schools and youth league games
- Discounts for taxpayers
- Reasonable concession prices

In Egypt, all the 22 soccer stadiums lose money annually as not depending on many and different sources of generating revenues although Egypt has a big potential as big fan base for Soccer. For example Cairo international stadium the oldest and one of the biggest soccer stadiums in Egypt lose about 38 Million per year according to the last financial statements 2016 / 2017 announced by “The Egyptian Ministry of Youth and Sports” although it has a prime location in Cairo that can be used for extra commercial and non-match day activities that can not only generate more revenues and mitigate the loses but also can result in a profitability scheme for the project that can drive later on more investors to invest and help in funding Egyptian soccer stadiums later on if a proper planning and a pre-feasibility model analysis is used pre the project execution start and after setting the project vision

In the United States, sports fans are used to pay a lot to watch their teams play. The average ticket price for National Football League games hit $92.98 in 2016, an increase of nearly 50% since 2006 - price growth which is more than twice the rate of inflation. A beer and a hot dog at Wrigley Field, home of Major League Baseball's Chicago Cubs, collectively run $13.50, and the cost for a family of four to attend a National Basketball Association game averaged $339 for the 2015–16 season. Even if fans never attend a game, they can end up subsidizing their local teams via public financing of their stadiums.

When the NFL's Atlanta Falcons moved into their new home later this year, they'll be able to thank $200 million in public bonds that helped with the construction. By contrast, voters in San Diego rejected a proposal in November to raise hotel taxes in order to contribute $350 million to a new stadium for their (now formerly) local football team, the Chargers. From 2000 to 2015, privately owned sports facilities cost US taxpayers $12 billion.

Do the economic benefits generated by these facilities—via increased tourism, for example we can take the case of Athens and the increase in the number of tourist visits during the 2004 Olympic Games, which were reported to be 1.9 million overnight stays according to "Marketing Sport and a City: The Case of Athens'' (Karlis, 2004).

On other hand there is another matter to consider about the public financing. According to (There a Better Way to Build a Stadium, 2016) (Semuels, Is There a Better Way to Build a Stadium, 2016) it has turned out to be generally acknowledged that freely financed sports stadiums are an awful arrangement for urban areas. However, in Milwaukee, situated in an express that as of late cut $250 million from its advanced education framework, the state has consented to contribute $250 million for another field for the Milwaukee Bucks b-ball group. The new working, to be fabricated only a couple of feet from the present field - the BMO Bradley Center - will kick things off in late June. There were a lot of proposed cases which were probably terrible thoughts. Take the case of St. Louis, approximately 400 miles toward the south of here. In 1995, the city, district, and state burned through $258 million to assemble a stadium planning to pull in a football group, inevitably drawing the Rams from Los Angeles. It didn't come shoddy as stadium support which was costly, to the tune of $6 million a year. That is much more than the city was making from amusements. Presently, the Rams are made a beeline for Los Angeles, and St. Louis was screwed over thanks to $144 million owing debtors and progressing upkeep costs, according to Reuters.

B- Private Financing

According to the private stadium initiative research (Kevin J. Delaney, public dollars private stadiums , 2003) on the "10 Alternatives for funding a stadium without tax increases" and "site selection and financing plan for a new multi-use stadium in San Diego" research there are several ways to finance the construction of stadiums according to (GIORDANO, 2015)

- The Fan-Lord stadiums share their ownership of an entire stake in a stadium instead of selling personal seats licenses.
- The development of hotels or boutiques to generate revenues all year and the possibility of partnering with the hotel developer.
- The retail development is a smart way of generating revenues from restaurants, parking, nightclubs, etc.
- Selling Naming rights of a stadium to a bank, investment group or retail company

3. Big Mac Index

“The Big Mac index, also known as Big Mac PPP, is a survey done by *The Economist* magazine that is used to measure the purchasing power parity (PPP) between nations, using the price of a Big Mac as the benchmark. Using the idea of PPP from economics, any changes in exchange rates between nations would be seen in the change in price of a basket of goods which remains constant across borders. The Big Mac index suggests that, in theory, changes in exchange rates between currencies should affect the price that consumers pay for a Big Mac in a particular nation” (The Economist, 2017)

Going to advantages of such a method which I recommend using it as a cost index benchmark in my model “The McDonald’s Big Mac is available across many countries around the world, with local McDonald’s franchises that can negotiate input prices. This enables a comparison between currencies of many countries. The Index has a good track record of predicting the direction of currencies, which can be used as a measure of inter-country wage differences”. (Big Mac Index, 2010)

However, limitations of the Big Mac theory states that “Exchange rates across the world should simply even out the prices of Big Macs that are sold all around the world, this is not always applicable as it can be shared only between those countries that are facing a similar stage of development. In some countries, the social status of fast food also alters the demand for Big Macs. Moreover, it can be distorted by transport costs, taxes, labor laws and trade barriers between different countries” (Big Mac Index, 2010)

4. Cost Impact of Stadiums on Community

According to what was wrote by Christopher Diedrich “The Public Financing of Stadiums’’ (Diedrich, 2007) in Policy Matters Journal, the financing for sports stadiums will stimulate economic growth into two primary ways which are:

First, it will create new jobs as building a new stadium means new construction jobs, and also the influx of capital attributable to the team's presence. This leads to having more income and spending which turns into more new jobs.

Secondly, it will increase tax revenues, as a fan’s spending on concessions and tickets or hotel rooms, meals and parking is all subject to sales taxes, therefore this new business results in an influx of capital.

The economists determined that the quantity of net number of changeless employments made some place till 1000 representing modified expense rates, property estimations, and wage expands. Financial specialists have evaluated that the estimation of these employments ranges till $ 1,500 for each activity made.

Therefore, a fair estimate of the economic benefit of job creation is approximately $ 375,000 per year and that is the product of the midpoint of job value ranges plus the job creation.

The economists estimate the annual sales tax benefit of a major league team ranging from $ 696,000 to approx. $ 1.5 million.

If there is an income tax in a country where the team plays, then another $ 1.2 million might flow into the city's treasures each year from the income taxes of players, coaches, and others who live or work in the area because of the presence of the team.

For example, the total annual economic benefit of a new stadium ranges from $ 1.1 million for the National Basketball Association (NBA) and the National Hockey League (NHL) arena with no local increase tax to $ 2.9 million for the Major League Baseball (MLB) stadium in an area with a local income tax.

On the other hand, not all economists agree that constructing a new stadium will even result in the relatively modest economic benefits above. For instance, the economists Dennis Coater & Brad Humphers's stated that the average impact of a professional sports franchise on a metropolitan area may actually even be negative.

Those economists' vision that public funds used to subsidize construction are not going to other public uses. In case tax increases are a non- starter, that means that those other public uses will be funded at a lesser level, which decreases the local economy's ability to be competitive in sectors other than sports.

Moreover, if the job creation benefits and tax revenue do exist, they might be less than ever increasing public expenditures to keep the team owners happy. An example that clears that out would be something like $ 84 million for the new National Basketball Association (NBA) or the national Hockey League (NHL) arenas and $ 188 million for new National Basketball Association (NBA) or the National Football league (NFL) stadiums.

Independent analysts, on the other hand, (Miller, 2004) are skeptical about such claims. For example, studies by (Baade, The Impact of Stadiums and Professional Sports on Metropolitan, 1990) & (Dye, 1990) find that sports teams and their stadiums, on average, do not provide significant impacts on local or regional economies although they find some small impacts in some cities.

In addition, they find a significant negative effect on the host cities' regional share of income and their regional share of retail sales in cities that had baseball stadiums built or renovated between 1965 and 1983.

Furthermore, Coates and (Humphreys,1999), examining the 37 cities in the United States with National Basketball Association (NBA), NFL, or MLB teams, find that the existence of these teams is negatively correlated with the level of real per capita income in a city. (Coates, 2000) examined specific industries within the same set of 37 cities as their 1999 paper and found that the presence of a sports team is associated with increased levels of employment and earnings in the amusement and recreation sector. The presence of a sports team, however, is associated with decreased employment and earnings in all other sectors by an amount that offsets the increase in the amusement and recreation sector. This suggests that spending on sports teams in a metropolitan area mostly represents spending that is merely redistributed within the area's economy.

5. Construction process of stadiums

According to the article at World Stadium site "Stadium Principles'' (Spampinato, 2004) there are numerous intentions that empower architectural creative ability there are many general principles relating to stadium construction which are:

First of all, functions and contents which is very important to build up a connection between a stadium, sports and the desires of the gathering of people. In order to accomplish this, few basic perspectives must be considered and appropriately incorporated thoroughly in arranging stages. These incorporate the steel or strengthened solid casings, levels, exhibitions, staircases, rooftops (regardless of whether murky or straightforward), tracks, rec centers, locker rooms, squeeze administrations (radio and TV), meeting rooms, and so on. A freely weave structure that needs "quality" won't confront the present gauges and will indicate hopeless destitution.

Three-dimensional point of view which is a stadium of an inalienably vast structure - one which is frequently hard to decide the beginning to the end, essentially on the grounds that each of its exterior sides is pervert representations of each other. A genuine test for the originator or planner is to either highlight the similarities from side to side or on the other hand make "breaks" in the stadium structure so as to vanquish an anachronism view.

The overall desired style & design related to the syntax of the stadium is very important to consider. Apprehending each of the separate critical aspects identified in the first guideline and determining how they will be allocated together is influential in achieving the desired style of the stadium.

According to Mendelsohn (Mendelsohn, stadium principles, 2017) “it was stated that the structural expressionism that ranges between the Soviet constructions to the captivating sketches from a rather historical style stadium to exciting experimental designs, i.e.; frames, pillars, roofs, lattices, curved surfaces and above all refractions and detractions of bright rays, and well-balanced proportions of clear and shaded spaces; are all aspects that contribute to many different results”.

The pitch of the stadium must be designed in a very impressive, creative way as it will be a focal point for performers, employees & the audience all alike aside from the framework & other parts of the stadium that will remain perpetual.

An architect should attend to the surroundings of the stadium whether it’s natural or urban, in order to maintain the adherence & harmonization between the stadium & its surroundings.

6. The International Association of Sports Economists (IASE)

IASE was established in July 1999 in Limoges (France) on the initiative of the Centre for Law and Economics in Sport (Centre de Droit et d'Economie du Sport, CDES). Right from the start, the profile and focus of IASE was developed across the triangle of economic pluralism, theory-practice dialogue, and universal scope. The current IASE holds international conferences in sports economics and sponsors periodic seminars. The conferences bring together and extend the reach of researchers in all areas of sports economics, whereas seminars and workshops aim to stimulate research and debate on challenging topics in sport policy. (The International Association of Sports Economists , 2017)

IASE has engaged a number of milestones in the development of international sports economics. The Association hosted the first international conferences in sports economics starting in 1999 in Limoges, and followed immediately by conferences in Lisbon, Portugal (2000), Malaga, Spain (2001), and New York, USA (2002). In recent years the association has hosted the first sports economics conferences in Africa (Stellenbosch, 2009) and South America (Rio de Janeiro, 2014). IASE, now more than ever, focuses on expanding the field worldwide. Today, IASE counts over 100 members from more than 20 countries.

The Association has been instrumental in providing outlets for published research in sports economics. It helped launch the Journal of Sports Economics in 2000 and served as the first official partner. IASE supported the publication of the influential reference volume “Handbook on the Economics of Sport” in 2006. Additionally, an open working paper series was created also in 2006. The association spurred the creation of continental scientific societies in North America (NAASE, 2007) and Europe (ESEA, 2010). Currently, IASE endeavors to establish a new journal on sport governance with the objective of fostering the exchange of ideas between disciplines as well as between academics and sports decision-makers.

Purposes of IASE (IASE)

1-Promoting the economics of sport.

2-Encouraging academic exchanges among researches.

3-Offering members all the necessary means to improve their knowledge and skills in the economics of sport.

4-Supplying expert analyses in the field of the economics of sport

Chapter 3: Stadiums Functioning and Planning

1. Introduction

This chapter illustrates and talks about:

1- The different zones that make up the stadia as proposed in the model

2- The different function components of the zones as proposed in the model

3- The relationship between zones and function components

2. Master Planning

Stadium Zoning

It is well-known that patrons zoning is restricted to three tiers. However, a greater diversity of products could be achieved through better definition of zones within the stadium. According to the FIFA safety measures and recommendations, five (5) zones should take place inside the stadium as shown in the picture below:

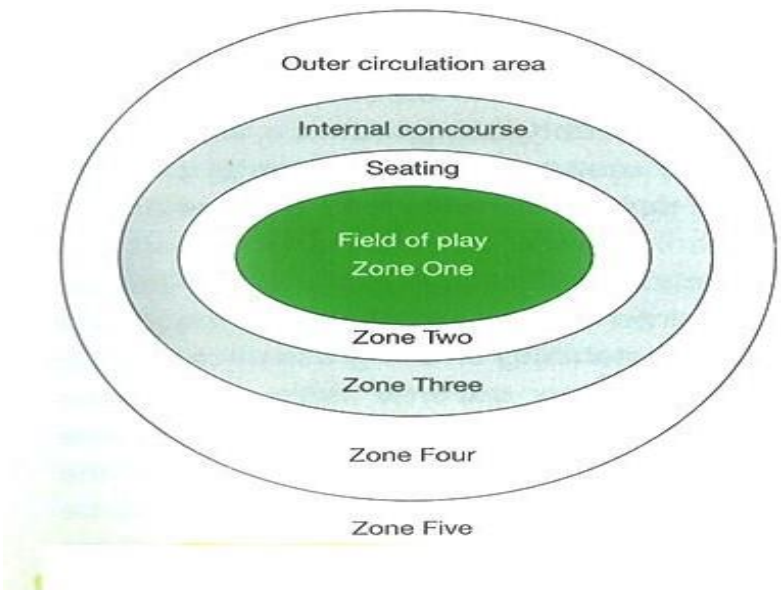


Figure (1): Zoning Diagram Showing 5 Safety Zones Form Basis for a Safe Stadium

Source: "Stadia Design and Development Guide" (John G. , 2007)

According to "Stadia Design and Development Guide" (John G. , Masterplanning, 2007), Circulation zones regarding a stadium are divided as follows,

Zone 1: The pitch or event space.

Zone 2: Viewing terraces around the pitch.

Zone 3: Internal concourses and social areas of a stadium including restaurants, shops, etc.).

Zone 4: Between the line of control and the actual stadium structure that is called place of "Temporary Safety".

Zone 5: That is a vehicles' free zone between the ring of parking areas and the stadium's perimeter.

A- Zone 1

The pitch represents the space of the playing area. It, also, can play a role in safety in a way of a temporary safety area, along with zone 4, depending on the following conditions:

- In case of any outer/external threats, regarding the design, the escape plan from the seating area to the pitch should be designed in a way that eases the escape plan for the spectators.
- The material of the pitch is a critical element regarding the safety of the people. The heat of high temperatures can ignite the pitch like the past fire accident that occurred in Valley Parade Stadium which fired up the clothes of the police and the spectators who were standing on the grass ground.

B- Zone 2

This zone forms the bowl terracing which is the viewing area. It can be discussed in different aspects such as the standards, areas, design, etc… A stadium can consist of more than 1 stage level depending on the targeting capacity, land size and height permissions. The route of the spectators in this zone begins between zones 2 and 3 where the tickets are checked and then stewards guide and escort the spectators to their seats. In addition, the seats should be sloped in a way that provides clear sights for all the spectators whether if they are seated or standing. The slope should not be the only thing to be considered, but also the area of the seat and the spacing between the seats and concourses is very important in regards to the safety and the pleasure of the spectators; this is demonstrated in details in chapter 4. On the other hand, the structural design in this zone is very critical and important because of the loads on the Reinforced Concrete are higher than a normal structural building. The loads are higher due to the cheering and jumping of fans which may result in reaching the maximum loads so this case should be highly considered. Also, the extremely loud noise, in major fixtures, can affect the structural system so it also should be considered in the design. Lastly, this zone should, most importantly, meet the design and safety standards of the FIFA along with the perfection of the structural design in order to meet the premium standards, requirements and needs of the project.

C- Zone 3

It is considered as a service zone for the spectators that includes all the facilities and services for the fans. Moreover, it consists of the food courts, toilets, store, etc.… According to the FIFA standards, every 1-meter depth should accommodate around 2000 fans. As long as the project has the minimal dimensions for the best quality of services, the stadium can attract more fans and spectators which will generate more revenues and, eventually improve the cash flows. On the other hand, zone 3 is, obviously, between zone 2 and 4 so it can be named as the middle core of the venue that fans pass by in order to reach the safest zones. Lastly, fire safety in this zone should be of a high level in order to minimize any risks on the spectators.

D- Zone 4

It is the inner safety zone which represents the safety area in order to be used in emergencies. If the fans needed to be evacuated outside the stadium, they head to zone 4 which is located between zone 3 and 5. It should have minimal standards (e.g. dimensions) according to the FIFA standards in order to have enough areas to accommodate from 4 to 6 people per m2. It is considered as a very important zone that should be presented and studied in the beginning of the urban planning process. Many stadiums worldwide don’t have this zone which can lead to big problematic disasters later on.

E- Zone 5

This zone is called the outer perimeter of the stadium and located between the venue and the outside streets. It can also be used for generating more profits for stadium through utilizing the pace areas in implementing boots and entertainment activities.

3. Zoning Main Construction Components

According to Stadia design and development guide (John G. , operation and funding, 2007), zoning construction components are divided as follows;

A- Accommodation

The accommodation of the spectators, inside and outside the bowl, regarding the capacity is a major subject in order to achieve highest satisfactions. In the facilities outside the bowl such as the food court, the accommodation per a single spectator is less than or equal to 1 m2. This capacity per spectator varies from one facility to another, even if between stadiums of equal capacity. This value varies between stadiums of same capacity, which may be considered as the single largest variable when it comes to cost comparisons. It depends on the area used for these facilities along with the quality. All of these factors depend on the budget, the total land area and the targeting income revenues. The accommodation area provided by Stade de France, as an example, equals to just less than 1 m2, while Wembley Stadium, also as an example, can offer up to 2 m2 per spectator because of its additional facilities that generate additional revenues. In this regard, the five broad categories that the accommodation areas can be divided into are as participant, operational, hospitality, spectator and non-core facilities

B- Vertical Circulation

In both normal and emergency conditions, the stadium has to meet the satisfaction of the best spectator experience regarding the circulation routes in, out and around the stadium. This circulation issue should be subjected in the design and ensure the highest efficiency in order to achieve the spectator's comfort and enjoyment. Furthermore, the more levels constructed, the less capacity for each stage is less than the stage below; but the costs per seat do not change. The additional costs of the above-ground levels are derived from the extra stairs, ramps, etc. Eventually, the costs per seat don't change but the costs of the vertical circulation increases.

C- Event Area

It is the area where the match/game or event takes place. It shall have specific dimensions according to the 'FIFA Standards and Regulations' (120 meters * 80 meters). In addition, the costs of the event area can be multiplied by a number of factors, including the suggested event calendar and the local climate conditions. Furthermore, the type of pitch ground - whether natural, artificial or synthetic - is a very important factor for the construction cost's variable in the different stadiums.

D- Bowl Terracing

The bowl terracing area is the spectators viewing area; and there are two primary criterions to be considered. First, the comfort of the spectator and the quality of the review through the seat width, depth of the row and value C affects the district plan and overall height of the bowl. The second factor is the point of confinement. Along these lines, more seats cost more money. In any case, the greater the bowl gets, the more essential the ordinary improvement costs will be. This is due to the additional cranes, the additional support structure and the expanded multifaceted nature of development.

E- External Perimeter:

It is the final and outer perimeter of the stadium. That mainly provides security for the fans at outer areas getting ready to pass in through turnstiles between zone 5 and zone 4

4. Other Sub components

A- Roof

Building roofs on bigger limit settings can cost extensive entireties of cash. Along these lines, the general structure is required to traverse longer separations and cover more prominent ranges. Also, the roof cost is identified with the spectators seeing territory for evident reasons.

B- Car Parking and Access

The issue of insufficient parking lots and long walking distances to the gates shall be addressed in order to reduce the stress on the local infrastructure. Pursuant to the FIFA recommendations, these areas should represent 10-15% of the stadium's capacity.

C- Barriers between Zones

The number of exit gates and their dimensions must allow the quick and easy access from one zone to another. Fortunately, the existence of digital equipment like turnstiles or CCTV or wireless technology nowadays allows the control points within the venue to be controlled automatically where they are left permanently open, unless a valid ticket is not received. The movements of the crowd shall be inadequately considered; thus, the evacuation routes and plan require reconsideration taking into account the recent events in the region. By virtue of the FIFA recommendations, the flow of 2,000 fans through one gate shall take one hour. That means a capacity of 45,000; about 22 gates shall be implemented in order to ease the flow of fans inwards and outwards.

Table (1): represents relationship between zones and components

Division	Components
Zone 1	Event Area
Zone 2	Bowl Terracing
Zone 3	Accommodation
Zone 4	Vertical Circulation
Zone 5	External Perimeter
Others	Roof
	Barriers between Zones
	Car Parking and Access

5. Stadiums Execution Procedures

Defining the Objectives and Criteria of the Project ‘’UEFA guide to quality stadiums (Fenwick, The procurement stratgy, 2011)

A- What do we want?

So, begin to ask ourselves the main first question; what is concerned with the starting point for any plans and unrealistic targets for new stadiums. This leads us to a more analytical and pragmatic discussion.

B- What do we need?

This question is about the main requirements and the feasible parameters. Thus, the agreement upon definitive objectives comes from the stadium's developers and other stakeholders.

C- What can be afforded?

Regarding the guidance for the success of any future projects, a pragmatic budget has to be defined through a detailed financial analysis of existing finances. This analysis should not be ignored because many previous cases did so and they all ended up in financial dilemmas. A lot of clubs before faced severe financial problems, due to the weakly planned stadium projects, that eventually led some of them out of the business. In conclusion, the financial plan should be balanced between the optimistic vision, the requirements and the financial pragmatics/reality.

D- Interpreting the process

In order to obtain the project's full picture of the financial and the strategic scopes, a new must be set in motion. According to the "UEFA guide to quality stadiums" book, the following four main points should be considered: the business plan, the financial viability study, the cost plan and, lastly, the operational plan. (Fenwick, The Procuremnt Strategy, 2011)

I. Business Plan

The business plan is concerned with explaining what is requested in order to make the stadium viable commercially plus the cost of elements. A stadium development project shall set out the anticipated sources of revenues, starting by the business plan. Therefore, a feasibility study must be carried out before the business plan is compiled. This procedure provides the stadium's developer with an initial evaluation of the project's financial and technical viability. It also helps to clarify the strategy of the subsequent businesses, in order to increase the 37 revenues through shared ownership and to use the stadium for other sports and commercial events.

II. The Financial Viability Plan

It is concerned with explaining a financing structure in order to attain the desired tasks and targets. Thus, the sources of potential revenues may include the following:

III. Construction Cost Plan

Comprehensively, one of the key elements considered in any business plan is the cost plan. All the potential expenses (CAPEX) - that are involved during the whole project cycle including financing, licensing, legal, professional and construction cost are provided and dispensed in a comprehensive and detailed analysis. Furthermore, expenses such as salaries along with the maintenance and many other projected operation costs (OPEX) are all included in the cost plan. In order to offset the expenses, the plan should also include all expected future income revenues. It is very important to ensure that the business plan has no actual costs obstacles. In this regard, the linear cost plan should include the main and major areas of work as follows:

- Construction costs
- Site acquisition
- Advertising and marketing
- Operating costs and funding

6. Planning and Feasibility

In the process of developing a new stadium, the crucial element is considered to be the planning and feasibility phase. A stadium idea can be viably created with a watchful research, investigation and arranging. Afterwards we can move into the outline, development and operation stages. That is to say, in the original planning phase of the development process, the most important step is the market and the financial feasibility. In this research, we will try to demonstrate the feasibility of a new stadium, as well as providing reference material for the entire project that form the basis for the identification of the following as per A Blueprint for Successful Stadium Development (Sartori, 2013)

1- Location and site assessment
2- Financial feasibility and funding
3- Analysis of mixed use development

A- Location and Site Assessment

Each project has its own different characteristics and uniqueness. The site should meet a few criteria with a specific end goal to meet the undertaking destinations, regardless of the base land estimate, the land cost, the design, construction, safety and security, or the operational viewpoint. At this stage, more contact will be required with people in general fields of specialization and different partners engaged with site acquirement or land ownership; and that is so as to empower more transparent discussions. This is also to expand the effectiveness of the planning approach in connection to the chose destinations.

First of all, there will be four main questions which need to be answered.

- Regarding the fans, what are the physical features required in the site in terms of size, location and visibility?
- How great are the transport joins including rail, fair, vehicle and public transport?
- Do the urban planning, zoning regulations of the site allow for a stadium development?
- What are the availability and costs of bringing the infrastructure and utilities to the site?

B- Financial Feasibility and Funding

There are five main different ways for funding of modern international stadiums

I. Contract-Backed Revenue

It serves as a source of the financing of the development. Thus, the triumph factors of raising finance include the large and loyal fan base that results in giving strong, real and high revenue streams.

II.. Equity Financing

It is through issuing shares. However, this has decreased recently in going public with an initial public offering (IPO) for building stadiums.

III. Debt Financing

It represents bank loans or bond issues. For example, when it comes to the construction of Juventus New Stadium, half of the cost which was about 65 Million Euros was financed by two commercial loan contracts. (Sartori, A Blueprint for Successful Stadium Development, 2013)

IV. Securitization

In order to raise financing for the stadium development project, securitization is an essential tool nowadays in the area of pre-sell of the future revenues. For instance, Arsenal and Emirates had an agreement that included an 8-year shirt sponsorship as a financing tool of the new stadium taking percentage of it before executing their new stadium in 2006. (Sartori, A Blueprint for Successful Stadium Development, 2013)

V. Public Authorities

The public authorities can play an important role in the financing of the stadium by many means. First, they have to benefit from the project in order to get attracted to the project. Some of these benefits for the country include higher income for the country, more job opportunities, developing the tourism, and developing areas that will result in attracting more investments, etc. On the other hand, the benefits that the project can obtain from the public authorities include tax allowances, providing the infrastructure, providing the land, providing transportation, etc. In addition, the public authorities can also contribute to financing through constructing access roads.

C- Analysis of the Mixed-Use Development

The new concepts, nowadays, for constructing stadiums is circulated around constructing a whole mixed-use sports complex area that includes commercial, administrative, residential or other traditional land uses. These uses are believed and predicted to secure higher returns and revenues that can support in the succeeding of the project along with the financing of the capital costs related to the project. For example, in Wembley stadium the estimated study has very low number in revenues estimated by only 12 million yearly. Using the space areas around Wembley to execute commercial and administrative areas with upgrading in normal seats to VIP boxes maximize the revenues to be 60 Million Pounds with percentage increase of 500 %

The stakeholders' vision is the key for putting hands on the ideas and concepts of a mixed-use development project. Regardless, the ideas must be doable and feasible so the types of functions considered along with their potentials, regarding the overall project, can be clearly assessed in the feasibility study.

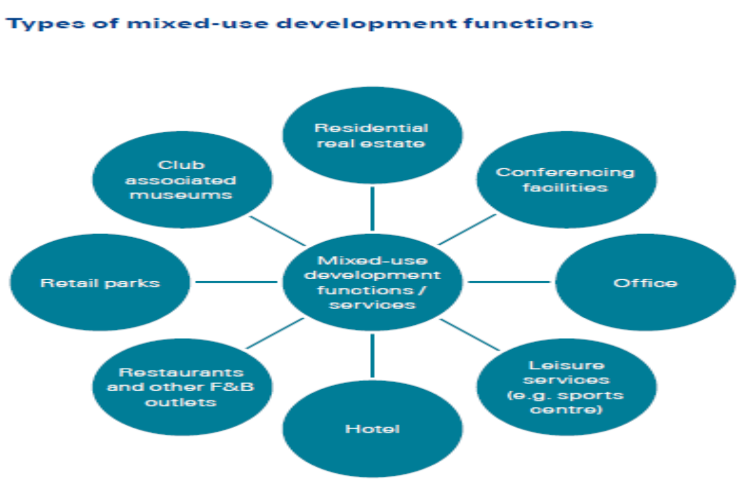


Figure (2): (Types of Mixed-Use Development Functions)

Source: (Sartori, A Blueprint for Successful Stadium Development, 2013)

Chapter 4: Model Development

1. Introduction

My model mainly consists of 4 parts; the first one includes the inputs of the project, the capital expenditures of the project, the revenues of the project; the cashflow and the feasibility outcome. The point is to see whether the project is feasible or not for the investor.

The model is created to be a dynamic one working for 56 countries. All parameters of stadiums are considered in the model with the first step of implementing the very conceptual data. The main idea of these data is the capacity items which has an impact on the costs of the stadium, the team tier where the team stands as ranking which affects our revenues stream. Then comes the optional variables of adding roofs, commercial areas, parking or not. Lastly, the country cost index according to international Big Mac index with stating the quality and revenues case in between minimum, maximum and mean.

In this regard, we shall state that our financial model depends on the entire above criterion, in addition to the cost of equity, the cost of the investor's debt. Using such data will give us the opportunity to calculate the net current value of the free cash flow of the project and the equity, using the above data to calculate the real debt to equity ratio, in order to execute the project in a macro loop calculation method as the case is with each one extra pound added to debt; all the free cash flows would change and that is why we are using the loop method.

That is to say, the model's idea is to be a dynamic model that guides the investor/sports club to know the viability of building a stadium from getting only the basic conceptual information through getting all of the Capex, Opex and revenues, and therefore getting the IRR and knowing the payback of the project.

This mainly relies on four (4) different sources: the data from previous international and Egyptian projects, the data of current projects and sponsorship deals, the “FIFA standards and regulations for building stadiums”, and the equations correlations driven to get some standard deviation based upon research and collected data. We have to know and analyze the team ranking category, weather A, B or C; and that is mainly based on the fan base of the team and how strong it is, plus the number of trophies and successes achieved by the club. Based on the current data, an Egyptian team for example of 'Category A' plays around 30 games per season between 15 games in the Egyptian league, 5 games in the Egyptian Cup and around 10 games in the African Champions League. (Egyptian Ministry of Youths and Sports)

The first given item is the capacity of the stadium and what is inside the owner’s mind to execute 20,000 or 40,000 or maybe exceeding the 100,000 fans. Therefore, every vision will have its own different numbers for the same parameters and variables. In addition, the roof is a common component in most of the big European and American stadiums, as they are used to either permanently or temporarily cover the event area according to the local environmental conditions of the concerned city; however, the roof is missed in most of the Egyptian and African stadiums. Here in the model, we can assume whether the roof will be executed or not.

Moreover, the parking fee per game is assumed according to the country big mac index; and the land cost is estimated as well based on the average prices of lands located at the outskirts of the cities away from the city center.

2. Inputs

To make the model workable and dynamic, a lot of considerations should be done. We start by choosing the country and then choose the quality case, revenue case then chooses steps / levels of different divisions. We will then proceed to the debt equity ratio percentage to know how much the club will pay from its own. If we don't have a decided percentage, we can get the optimum one as cost of debt will always reflect to increase IRR of equity side.

Working on several sheets on excel financial model, the Fx sheet includes currency exchange in dollars for the 56 concerned countries of the model. That is due to the fact that these countries have the Big Mac index; while financial data sheet represents NPV as if building the stadium in USA today, tax rate, corridor rate and ticket price for each country.

Going to the Big Mac sheet as the method chosen to be used as an international benchmark cost index. All the indexes of the Big Mac for each country in the last 7 years starting 2010 till 2017 are implemented to know the purchasing power in each country as these will be also used with the initial cost in the next sheet where I got 10 stadiums in each capacity term (20,000 – 40,000 – 60,000 – 80,000) to get the nearest exact numbers in cost sheet according to the country, quality case, revenue case chosen in the feasibility sheet. As for the revenues, the same procedure with cost will be done but for only 3 stadiums in each revenue term representing the current data of 2017 not old data as stadiums costs. Then from the zoning sheet I can got the land size from the given parameter of the capacity as will be illustrated in the following section.

3. Calculation of areas

A- Zone one

This includes the pitch area where the main game takes place; in addition to a track area around the pitch

$$A_{z1} = ((L + 40) \times (W + 40))$$

Equation (1)

A_{z1} = Area of zone 1

L = Length of pitch

W = Width of pitch

The official length and width of the gaming area is 100 and 64 meters respectively according to the FIFA Standards. However, the pitch area is recommended to be extended between 2 to 4 meters from each side after the line marking of gaming area outer borders.

For the track, around the pitch is the area where you can find the Substitutes' benches, photographers' positions and pitch access and tunnel. According to the standards, the minimum width of the track should be 20 meters all around the pitch area.

Thus, there is a constant of 40 meters added to the above formula for both the length and the width in order to get the full area in meter square for zone 1.

B- Zone Two

This includes spectator viewing accommodation which requires a series of formulas to calculate the number of rows per step.

According to the standards, there is a fixed percentage of the total capacity of the stadium for each step as follows:

Step 1 = 51%

Step 2 = 4%

Step 3 = 45%

Thus, after calculating the number of seats per step, we have to calculate the 'C' value which is the vertical distance in millimeter between each spectator line of sight and the eyes of the person in front.

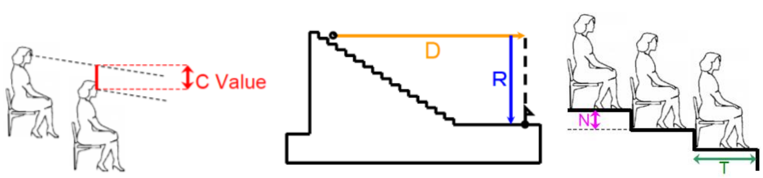


Figure 3: represents the spectator viewing accommodation ((Spectator accommodation-seating, 2008)

To calculate the appropriate 'C' value for the sport to be viewed, the following formula applies:

$$C = \frac{D(N+R)}{D+T} - R$$

(Spectator accommodation-seating, 2008)

Equation (2)

C = the ‘C’ value

D = the horizontal distance from the eye to the point of focus

N = the seating step height

R = the vertical height between the eye and the point of focus

T = the seating row depth

However, there is a reference of the ‘C’ value can be calculated by another formula which is

$$C = H - R$$

(Spectator accommodation-seating, 2008)

Equation (3)

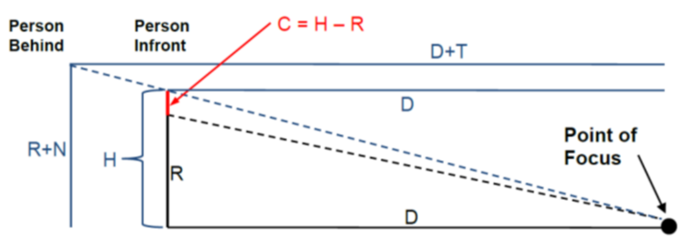


Figure 4: represents the seating steps (Spectator accommodation-seating, 2008)

In addition, the seating step height which is “N” and the seating step width “T” can be calculated using the formula:

$$N = \frac{(R + C) * (D + T)}{D} - R$$

Equation (4)

Based on the capacity and the distribution of the seats on the steps, we can use the following formula to determine to total depth of the stadium while taking into consideration the stadium coverage and its depth

$$D_T = (S1 + S3 - (V \times S1) + D_c)$$

Equation (5)

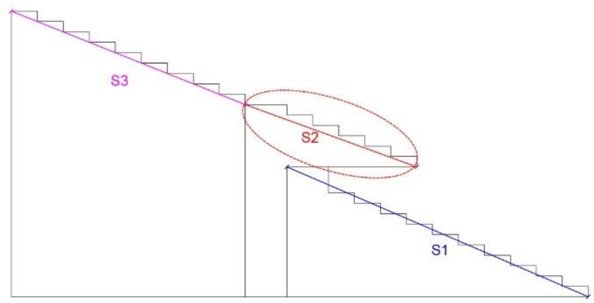


Figure 5 represent different Stadium Steps

D_T = Stadium Total Depth per side

S1 = Step 1 Depth

S3 = Step 3 Depth

V = Stadium Coverage %

D_c= Coverage Depth which is equal to 4

Finally, we can get the total depth of the spectator zone

$$A_{z2} = \big((L + 40 + 2D_T) * (W + 40 + 2D_T)\big) - ((L + 40) * (W + 40))$$

A_{z2}= Area of Zone 2

Equation (6)

C- Zone Three

The leisure zone is represented by the concourses and hospitality areas which are:

- General public entrance and areas.
- Public toilet facilities.
- Public concession stands.
- Public first aid facilities.
- Commercial and host city displays.
- Spectator accommodation.

In order to calculate the area of this zone, we will start calculating the zone's depth proportionally to the stadium capacity using a constant of 2000 according to the FIFA standards:

$$A_{z3D} = Sc\ /2000$$

Equation (7)

A_{z3D}= Depth of Zone 3 per side

Sc = Stadium Capacity

Afterwards, we then calculate the area of the zone using the below formula

$$A_{z3} = \big((L + 40 + 2A_{z3D} + 2D_T) * (W + 40 + 2A_{z3D} + 2D_T)\big) - ((L + 40 + 2D_T) * (W + 40 + 2D_T))$$

Equation (8)

A_{z3}= Area of Zone 3

D- Zone Four

It is the outer circulation area for security. Zone Three and Four may, in certain situations, be considered a place of reasonable safety, to which spectators can be evacuated before exiting to Zone Five. In planning terms, Zone Four can serve as a vital access area for emergency and service vehicles, without disrupting circulation in Zone Two.

$$A_{z4} = Sc\ / f(s)$$

Equation (9)

A_{z4}= Area of Zone 4

$f(s)$ = Safety factor

According to the researches, it was concluded that the optimum area for security is to divide the chosen stadium capacity by a safety factor which was reached to be equal to 6.

E- Zone Five

A buffer zone outside the sports ground perimeter referred to be the outer entrance and exit zone, used for the public to gather before entry and for links to car parks and public transport. The public should be able to circumnavigate the perimeter in this zone, in order to find an appropriate point of entry. Zone Five should be the designated place of safety in the event of an emergency.

$$A_{z5} = Sc\ /f(s)$$

Equation (10)

A_{z5}= Area of Zone 5

Thus, we can conclude that the meter square for both zone 4 and 5 should be identically equal for the same stadium since the capacity and safety factory will remain the same

4. Calculations of Costs

A- Database

The database used to calculate the costs of constructing a stadium is divided into a several data. The data used are based as the following:

I) Historical Data

The historical data gathered on existing 40 stadiums from 15 different countries divided equally into 4 categories, 10 stadiums each, according to their capacities as shown in the figure below (figure 5). It provides the country, year of construction, capacity and cost. The data is driven then divided to the different 5 stadiums' main components according to the percentages of each to eventually get cost per seat.

While in some other cases cost per seat is given therefore no calculations needed for the 20,000 and 75,000 capacity cases as in the figure below

		Accommodation	Vertical Transportation	Roof	Bowl Terracing	Event Area	Year	Total	Capacity
Capacity 20,000 & less	Australia	5872.5	622.8432	889.776	1334.664	177.9552	2010	X	20,000
	Ukraine	42556.0146	4513.5167	6447.881	9671.8215	1289.5762	2011	X	20,000
	France	2692.8	285.6	408	612	81.6	2011	X	20,000
	France	2647.26	280.77	401.1	601.65	80.22	2012	X	20,000
	New Zealand	4234.23	449.085	641.55	962.325	128.31	2011	X	20,000
	United States	2978.976	315.952	451.36	677.04	90.272	2012	X	20,000
	Britain	1963.104	208.208	297.44	446.16	59.488	2011	X	20,000
	Germany	866.58	91.91	131.3	196.95	26.26	2011	X	20,000
	Brazil	6941.832669	736.2549801	1051.792829	1577.689243	210.3585657	2013	X	20,000
	France	4631.70896	491.2418594	701.7740849	1052.661127	140.354817	2013	X	20,000
Capacity 40,000 & less	Australia	5872.5	622.8	889.8	1334.7	178.0	2010	267,377,688	30,050
	Ukraine	42556.0146	4513.5167	6447.881	9671.8215	1289.5762	2011	2,251,277,651	34,915
	France	2692.8	285.6	408	612	81.6	2011	102,000,000	25,000
	France	2647.26	280.77	401.1	601.65	80.22	2012	100,988,958	25,178
	New Zealand	4234.23	449.085	641.55	962.325	128.31	2011	197,263,794	30,748
	United States	2978.976	315.952	451.36	677.04	90.272	2012	99,475,230	22,039
	Britain	1963.104	208.208	297.44	446.16	59.488	2011	66,924,000	22,500
	Germany	866.58	91.91	131.3	196.95	26.26	2011	43,985,500	33,500
	Brazil	6941.832669	736.2549801	1051.792829	1577.689243	210.3585657	2013	330,000,000	31,375
	France	4631.70896	491.2418594	701.7740849	1052.661127	140.354817	2013	250,000,000	35,624
Capacity 60,000 & less	France	4134.40	581.40	775.20	904.40	64.60	2012	324,014,220	50,157
	Sweden	37632.00	5292.00	7056.00	8232.00	588.00	2012	2,940,000,000	50,000
	South Africa	27697.15	3894.91	5193.22	6058.75	432.77	2010	2,097,150,451	48,459
	Poland	10905.60	1533.60	2044.80	2385.60	170.40	2011	743,199,600	43,615
	Italy	1951.36	274.41	365.88	426.86	30.49	2011	125,009,000	41,000
	Turkey	4473.41	629.07	838.76	978.56	69.90	2011	368,007,705	52,650
	Brazil	6454.56	907.67	1210.23	1411.94	100.85	2012	610,561,035	60,540
	Turkey	4708.05	662.07	882.76	1029.89	73.56	2016	320,000,000	43,500
	Russia	279082.8924	39246.03175	52328.04233	61049.38272	4360.670194	2014	19,780,000,000	45,360
	Spain	2762.296159	388.4478973	517.9305298	604.2522847	43.16087748	2013	230,000,000	53,289
Capacity 80,000 + & - 20,000	France	3307.52	465.12	620.16	723.52	51.68	2012	X	75,000
	Sweden	30105.6	4233.6	5644.8	6585.6	470.4	2012	X	75,000
	South Africa	22157.7216	3115.9296	4154.5728	4847.0016	346.2144	2010	X	75,000
	Poland	8724.48	1226.88	1635.84	1908.48	136.32	2011	X	75,000
	Italy	1561.088	219.528	292.704	341.488	24.392	2011	X	75,000
	Turkey	3578.7264	503.2584	671.0112	782.8464	55.9176	2011	X	75,000
	Brazil	5163.648	726.138	968.184	1129.548	80.682	2012	X	75,000
	Turkey	3766.436782	529.6551724	706.2068966	823.908046	58.85057471	2016	X	75,000
	Russia	223266.3139	31396.8254	41862.43386	48839.50617	3488.536155	2014	X	75,000
	Spain	2209.836927	310.7583179	414.3444238	483.4018278	34.52870198	2013	X	75,000

Figure (6) represent initial costs given for different stadia (excel model)

II) Big Mac Index

The database of the Big Mac Index varies to the extent of 56 different countries, from 2010 until today, in order to have a wider range of information and results. The Big Mac Index is used in order to compare between the purchasing power parity (PPP) between two currencies and provides a test of the extent to which market exchange rates result in goods costing the same in different countries.

III) The Forex Rates

The FX Rate is depicted by providing the FX rates of the same 56 countries provided in the Big Mac Index in order to calculate the costs in the local currency of a certain chosen country.

IV) The NPV Factor / Discounting Rate

The NPV is used to know the time value of money. Therefore, it is used in the model in order to calculate the value of money in a certain time. The NPV factors are given from 2010 to 2017 in reference to the USA because the USD is the most stable, risk free currency and used as the datum currency of the world.

Table (2): represent NPV Factor according to corridor rates in USA

USA								
Year	2010	2011	2012	2013	2014	2015	2016	2017
NPV FACTOR	1.1276	1.0931	1.0709	1.0555	1.0386	1.0374	1.025	1.01

V) Corridor Rates

The corridor rates of the central banks are provided for the 56 countries in order to be able to calculate the interest rates and to use it as an assumption for the weighted average cost of capital (WACC).

VI) Tax Rates

The tax rates of the 56 countries are put in the database in order to calculate the project's financial sheet after calculating the costs.

VII) Zoning Construction Components Percentages:

The Percentages of each zone vary according to the capacities. It is shown in the table below (Table 3):

Table (3) Represents Standard Capex Percentage for stadia components (John G. , Operation and Funding, 2013)

Capacity Capex %				
Tier	20000 or less	40000 or less	60000 or less	80000 (60000<)
Accommodation	69%	66%	64%	58%
Vertical Transportation	5%	7%	9%	9%
Roof	8%	10%	12%	17%
Bowl Terracing	14%	15%	14%	15%
Event Area	4%	2%	1%	1%

B- Calculating Cost across Countries

In order to calculate the cost across countries the database needed in this step is the historical data, Big Mac Index and the FX rates.

The equation used is the following: $(\frac{I_t}{FX_t}) * (\frac{B_{US-t}}{B_{I-t}})$ ***Equation (11)***

I: The cost, from the historical data, required for calculation

t: time in the historical data.

T: The time now.

B: Big Mac Index

Fx: Forex Rate

The first half of the equation (I_t/Fx_t) calculates the cost in USD at time (t) in order to convert whichever currency to USD. The result is calculated by dividing the cost at time (t) by the forex rate at the same time (t).

Multiplying the first half (I_t/Fx_t) by the second half of the equation (B_{US-t}/B_{I-t}) calculates the value in USA in USD at time (t) by dividing the Big Mac rate of the USA by the Big Mac of the country from the historical data.

C- Calculating Cost across Time

In order to calculate the cost across time, the database required in this step is the Discounting Rate/NPV Factor, Big Mac Index and the Forex Rates Index.

The equation used is the following: $DR * (\frac{B_C}{B_{US-t}}) * FX_{C-t}$

Equation (12)

DR: Discounting Rate

t: Time in the historical data

T: The time now

B: Big Mac Index

B_{US}: USA Big Mac Index

B_C: Chosen Country Big Mac Index

Fx: Forex Rate

First, it is required to multiply equation 12 to the DR in order to get the value in USA in USD in time (T). Then when it is multiplied by (B_c/B_{us-t}) it outcomes the value of the cost in the country input in USD at time (T). In addition, multiplying all the previous by (Fx_{c-t}), which is the Forex Rate of the country input at time (T), will result in our final required value which is the value in country input in its local currency at time (T)

D- Calculating the Mean Per Capacity

In order to calculate the Mean, Case Min and Case Max it is required to calculate the Variance (VAR) and the Standard Deviation(σ).

The equations used in this division are the following:

VAR = $\sum_{n=1}^{n=n-1} \frac{(Cn-mean)^2}{n-1}$ ***Equation (13)***

$\sigma = \sqrt{VAR}$ ***Equation (14)***

Mean = $\sum \frac{Cn}{n}$ ***Equation (15)***

Case Min = Mean – σ ***Equation (16)***

Case Max = Mean + σ ***Equation (17)***

Where, (C_n) is the sum of the costs of a certain number (n) of stadiums from the historical data.

The first step for calculating the mean is the summation of the dividing of the C_n by n. Then the mean is used in calculating VAR and so calculating the standard deviation is available by square root of VAR. Finally, subtracting σ from the Mean results in Case Min while adding σ to the Mean results in Case Max.

E- Costs for commercial area

Here Egypt is taken as reference in costs, as knowing the costs of infrastructure and construction of commercial use lands; then through the same methodology of Big Mac index we can get the other chosen countries

$$= X * \frac{(FX_C * B_C)}{(FX_{Eg} * B_{Eg})}$$ **Equation (18)**

X: cost with regarding to Egyptian market

FX_c: cost after changing currency to the chosen country

B_c: Big Mac index for the chosen country

B_{Eg}: Big Mac index for Egypt

F- Summary

In order to be able to calculate the costs, the following databases should exist: Historical Data, Big Mac Index, Forex Rates, The NPV Factor / Discounting Rate, Corridor Rates, Tax Rates and Zoning Construction Components Percentages. The cost of a certain stadium, from the historical data, is divided into 5 parts which are the accommodation, vertical transportation, roof, bowl terracing and event area; and also divided into tiers according to the capacities. Afterwards, the costs are calculated separately across country and time and then added together. So, it is known by the end how much is the cost for each division, according to the Zoning Construction Components Percentages, and so the total cost is calculated by adding all the costs.

On the other hand, the benchmarks used in the calculations are USA and USD because the USD is the most stable, risk free currency and used as the datum currency of the world. So, it relates any input to the USD at time (t) and time (T) also the USA Big Mac index at time (t) and time (T). It relates at time (t) in order to get the value in the past in USD in USA then drive it to time (T) in USD in USA in order to get the value in the local currency of the input country at the country itself by time (T). Then in the end, the Mean, Case Max and Case Min are calculated by equations 13, 14, 15, 16 and 17. The full process of calculating the costs is comprehended in the following equation:

Cost per stadium per division = $\left(\frac{I_t}{FX_t}\right) * \left(\frac{B_{US-t}}{B_{I-t}}\right) * \ DR * \left(\frac{B_C}{B_{US-t}}\right) * FX_{C-t}$ **Equation (19)**

5. Revenues Calculations

A- General

Revenue actual data are collected from different countries dependent on 3 different tiers A, B and C according to team ranking and fan base. Then each revenue item is pivoted upon 2 different criteria

1. Country of Origin
2. Type of Revenue

While all are approached using the USD currency and shown as illustrated in the table below

Table (4): represents the Revenues in USD currency (excel model)

Revenue USD				
Tier		A	B	C
Sponsorship	Turkey	6,000,000	4,200,000	2,940,000
	Germany	10,000,000	7,000,000	4,900,000
	United states	16,000,000	11,200,000	7,840,000
VIP seats multiples	Stadium 1	25	18	12
	Stadium 2	20	14	10
	Stadium 3	24	17	12
Named Stadia	Turkey	8,000,000	5,600,000	3,920,000
	Germany	13,000,000	9,100,000	6,370,000
	United states	22,000,000	15,400,000	10,780,000
F&B	United states	13,000,000	9,100,000	6,370,000
	Germany	6,000,000	2,800,000	1,960,000
	Turkey	2,000,000	1,400,000	980,000
Non-Event Day Activities	Egypt	2,000,000	1,400,000	980,000
	Britain	20,000,000	14,000,000	9,800,000
	India	12,000,000	8,400,000	5,880,000

All revenues are a monetary value except the VIP as it is calculated depending on a factor which is:

1. Percentage of VIP seats as of total capacity of stadium
2. Number of games played
3. Normal average ticket price

The 3 points above should be equal to the revenue of a normal seat throughout the whole year in all games multiplied by the ticket price.

Then the VIP seat is always a factor of the above number as of 25 times for example.

B- Calculations

As the numbers above are on time T (today) We shall transfer the above number to the country of choice in the inputs using our big mac index which then shall be viable value for the usage in our model; that is proven later in the validation section.

And to do the above step the equation that was used is:

Y= Current Data gathered from the Revenue excel sheet

FX_c= currency exchange rate from USD to currency of country of choice in Input

B_c= Big Mac Index Value for country of choice in Input

B_x= Big Mac Index Value for the country of X (Data gathered in the General Section)

$$z_1 = Y * FX_c$$ ***Equation (20)***

This is the Revenue in country of Y but in the Local currency of country chosen in Input

(Z_1)

$$z_2 = z_1 * \frac{B_C}{B_y}$$ ***Equation (21)***

This is the Revenue in country of choice in input plus local currency of same country

(Z_2)

C- Standardization of Quality and Revenue Base

Choosing quality or revenue case of a stadium is one of the parameters used in the model to define the quality standards that is a sensitive parameter to the cost of the stadium and the revenue standard as a sensitive parameter to the net cashflow of the stadium at the end. It is defined according to given data for different stadiums worldwide with big variance in cost and revenue for each according to country and stadium quality. Three different standards are implemented for the case minimum, case maximum and mean. This at the end leads to difference in Project total cost, IRR AND NPV. It is important to identify the quality case according to the different criteria like architectural shape of the stadium, amenities, seats quality, and safety measures while identifying the revenue case will be mainly according to the revenue stream dependent on the financial statements and sponsorships engagement of the chosen sports team and the economy standards of the country itself the sports team affiliated to while team tier as team ranking if A, B or C as due to team category ranking worldwide plus the most important thing which is the fans base engagement to matches attendance to the concerned sports team.

D- VIP Calculations

As mentioned in the General section above, VIP depends on a multiple factor, and accordingly the equation shall be:

VIP: the revenue from the VIP section

F: Factor achieved

T_p: Price per normal ticket

G: Number of games played per year

P_v: Percentage of VIP seat of the total Capacity of the Stadium

$$VIP = F * T_p * G * P_v$$ **Equation (22)**

Using all the sections above this shall be the output table from the table in the general section plus

- Fixed data
    - Ticket Price
    - Percentage of VIP from total Capacity
- Some user inputs as
    - Games Played/ year

And accordingly, the final output table below to be used for the revenues shall be as follows according to Egypt as the country chosen in the model for 20,000 capacity examples in LE local currency showing different cases for three different revenue cases minimum, mean and maximum so the below table show some of the revenue items which mainly the same in all capacities while what will differ and what is variable with capacity will be for example the seating tickets and parking area tickets.

Table (5): represents final outputs of revenues representing Egypt case (excel sheet)

VIP seats multiples	Stadium 1	25	18	12
	Stadium 2	20	14	9.8
	Stadium 3	24	16.8	11.76
	Mean	23	16	11
	Variance	7.0	3.4	1.7
	St. Dev.	2.65	1.85	1.30
	Case Min	20.35	14.25	9.97
	Case Max	25.65	17.95	12.57
	Mean	23	16	11
Named Stadia	Stadium 1	83,483,303	58,438,312	40,906,819
	Stadium 2	91,568,516	64,097,961	44,868,573
	Stadium 3	130,215,094	91,150,566	63,805,396
	Mean	101,755,638	71,228,946	49,860,262
	Variance	623,798,168,397,768	305,661,102,514,906	149,773,940,232,304
	St. Dev.	24,975,952	17,483,166	12,238,216
	Case Min	76,779,686	53,745,780	37,622,046
	Case Max	126,731,590	88,712,113	62,098,479
	Mean	101,755,638	71,228,946	49,860,262

F&B	Stadium 1	76,945,283	53,861,698	37,703,189
	Stadium 2	42,262,392	19,722,450	13,805,715
	Stadium 3	20,870,826	14,609,578	10,226,705
	Mean	46,692,834	29,397,909	20,578,536
	Variance	800,807,798,879,913	455,393,112,848,417	223,142,625,295,725
	St. Dev.	28,298,548	21,339,942	14,937,959
	Case Min	18,394,286	8,057,967	5,640,577
	Case Max	74,991,381	50,737,850	35,516,495
	Mean	46,692,834	29,397,909	20,578,536
Non-Event Day Activities	Stadium 1	11,837,736	8,286,415	5,800,491
	Stadium 2	140,874,640	98,612,248	69,028,573
	Stadium 3	125,224,955	87,657,468	61,360,228
	Mean	92,645,777	64,852,044	45,396,431
	Variance	4,958,682,765,495,180	2,429,754,555,092,640	1,190,579,731,995,390
	St. Dev.	70,417,915	49,292,541	34,504,778
	Case Min	22,227,862	15,559,503	10,891,652
	Case Max	163,063,692	114,144,584	79,901,209
	Mean	92,645,777	64,852,044	45,396,431

E- Revenues of commercial areas

Same procedure as in costs, we will take Egypt as our reference in revenues of commercial area since the data available taken from the Egyptian construction market as construction costs and revenues. Then by methodology of Big Mac we can get revenues of other countries

$$X * \frac{(FX_C * B_C)}{(FX_{Eg} * B_{Eg})}$$

Equation (23)

X; revenue with regarding to Egyptian market

FX_c; revenues after changing currency to the concerned country

B_c; Big Mac index for the concerned country

B_{Eg}; Big Mac index for Egypt

6. Feasibility Outcome

We have different parameters to implement at first like the country chosen, the quality case and revenue case as illustrated before, number of steps, debt ratio, revenue growth, capacity of the stadium, team tier per club ranking and previous successful history, existence or non- existence of roof, commercial area, stadium parking and the average games per season. All of items affect the costs and profits of the project and make it changeable to be higher or lower. Then outputs will be driven as shown in table 7 as total project cost, IRR and NPV and payback period considering interest rate and taxes of the chosen country. The case done in the tables below and taken from excel model which is done on a stadium of 20,000 capacity in Egypt with team tier A as ranking standard of the concerned sports team club which will build the stadium for its own (Chapter 4.5.C) 70 % of debt and 30 % of equity and revenue annual growth of 15 % including a roof and stadium parking but without commercial area and not considering the land cost as I need to analyze the impact of stadium construction as a project away from land cost with medium quality and revenue cases (Chapter 4.5.C) while average games per season estimated to be 30 games. The inputs are driven as in the tables below.

Table (6) Feasibility inputs (excel sheet)

Financing	
Debt %	70%
Rev Growth	15.00%
Quality Case	Mean
Revenue Case	Mean
Country	Egypt
Capacity	20,000
Team Tier	A
Roof	YES
Commercial	NO
Stadium Parking	YES
Avg. Games per season	30
Land Down Payment	20 %
Installment years	8
Land Price	0

Table (7) Feasibility outputs (excel sheet)

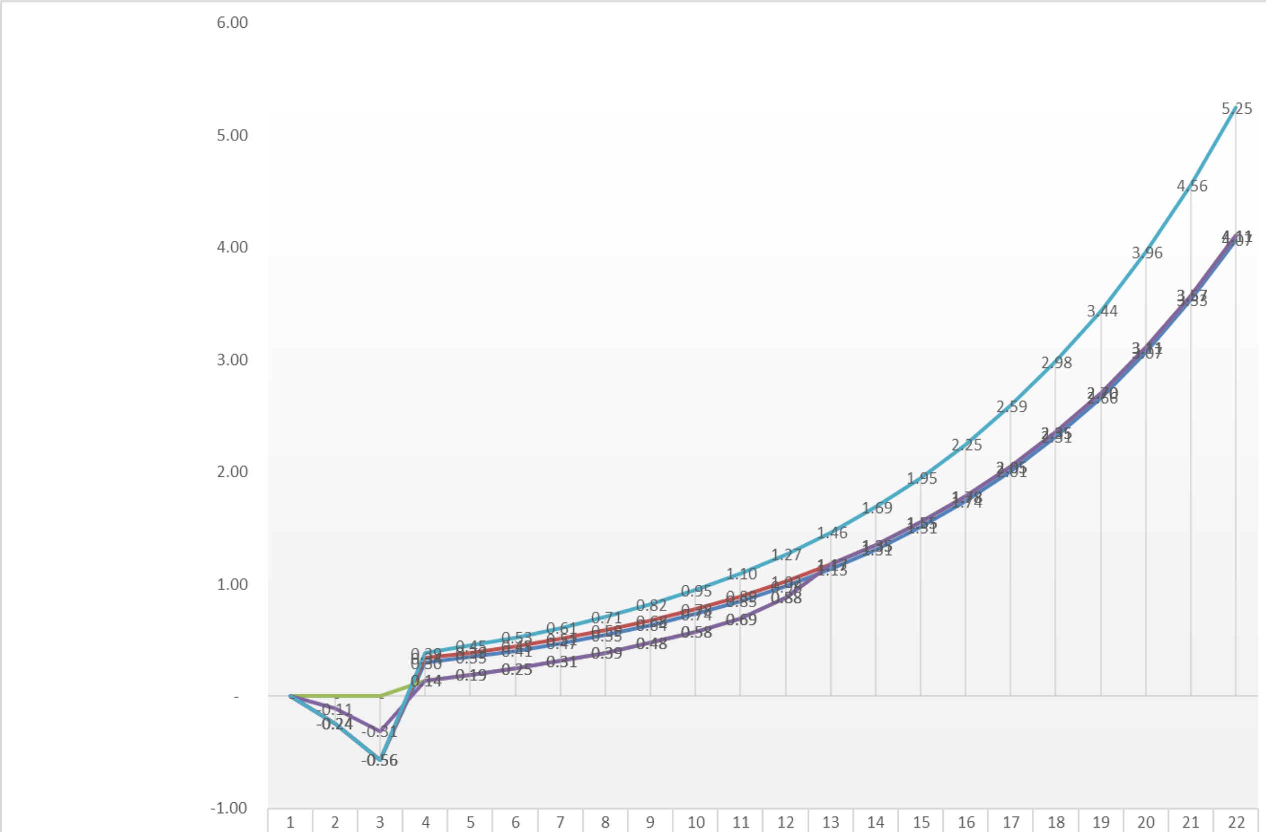
Project Outcome	
IRR	51%
NPV	2,087,979,402.32
Interest	20.75 %
Taxes	22.5 %
Equity Outcome	
IRR	55%
NPV	1,814,267,022.18
Equity %	30%
debt years	10
Total Project Cost	1,030,056,063
real Debt %	55%
Real Equity %	45%
debt no.	563,388,935
equity no.	466,667,128
Payback Period	5 years 5 months

7. Cash Flow

Here and after implementing all the parameters for stadium components with assuming operation costs as percentage of total revenues by 20 %. So, items below in the table illustrate EBIT, project cash flow, operating cash flow and net cash flow

	0	1	2	3	4	5
I. Initial Investment						
Land	0	0	0	0	0	0
Accommodation		159358585	371836697			
Vertical Transportation		16901668	39437225			
Roof		24145240	56338894			
Bowl Terracing		36217860	84508340			
Event Area		4829048	11267779			
General Com.		-	-			
Music Hall		-	-			
Parking		-	-			
F&B		-	-			
Administrative		-	-			
Commercial		-	-			
Total Investment Cost	-	(241,452,401)	(563,388,935)	-	-	-
II. Project Cash Flows						
Sponsorship Revenue				75,917,228	87,304,812	100,400,534
Advertising Revenue				-	-	-
Seating Revenue				67,506,660	77,632,659	89,277,558
VIP Boxes Revenue				146,132,064	168,051,874	193,259,655
Named Stadia Revenue				101,755,638	117,018,983	134,571,831
Stad. Parking Revenue				1,954,944	2,248,186	2,585,413
Television Revenue				46,692,834	53,696,759	61,751,272
Non-Event Day Activities Revenue				92,645,777	106,542,643	122,524,040
Museum Revenue				1,764,880	2,029,612	2,334,054
OPEX Stadium				(106,874,005)	(122,905,106)	(141,340,871)
Music Hall Revenue				-	-	-
Com. Parking Revenue				0	0	0
F&B Revenue				0	0	0
Mixed Use Rent Revenue				0	0	0
Commercial Revenue				-	-	-
Kiosk Revenue				-	-	-
Ads Revenue				-	-	-
Depreciation				$ (40,242,066.81)	$ (40,242,066.81)	$ (40,242,066.81)
EBIT	$ -	$ (241,452,400.83)	$ (563,388,935.28)	$ 387,253,952.43	$ 451,378,355.32	$ 525,121,418.64
Taxes	$ -	$ -	$ -	$ (87,132,139.30)	$ (101,560,129.95)	$ (118,152,319.19)
EARNINGS	$ -	$ (241,452,400.83)	$ (563,388,935.28)	$ 300,121,813.14	$ 349,818,225.37	$ 406,969,099.45
Depreciation (added back)	$ -	$ -	$ -	$ 40,242,066.81	$ 40,242,066.81	$ 40,242,066.81
Operating Cash Flows	$ -	$ (241,452,400.83)	$ (563,388,935.28)	$ 340,363,879.94	$ 390,060,292.18	$ 447,211,166.25
III. Equity Cash Flow						
Loan	-	193,161,921	450,711,148			
Equity Contribution	-	107,687,771	310,668,756			
Principle 1	-	-	-	-	-	-
Principle 2		(19,316,192)	(19,316,192)	(19,316,192)	(19,316,192)	(19,316,192)
Principle 3			(45,071,114.82)	(45,071,114.82)	(45,071,114.82)	(45,071,114.82)
Interest		(40,081,098.54)	(133,603,661.79)	(133,603,661.79)	(133,603,661.79)	(133,603,661.79)
Net Cash Flow	$ -	$ -	$ -	$ 142,372,911.26	$ 192,069,323.50	$ 249,220,197.57
Cash Flow to Equity Holder	$ -	$ (107,687,770.77)	$ (310,668,755.74)	$ 142,372,911.26	$ 192,069,323.50	$ 249,220,197.57
Analysis						
Project IRR	51%					
Equity IRR	56%					
PROJECT CF DISCOUNTED	-	(159,714,671)	(392,877,601)	198,206,047	189,683,543	181,608,022
EQUITY CF DISCOUNTED	-	(89,927,157)	(216,643,934)	82,908,832	93,401,945	101,205,852
Project NPV	2,087,979,402					
Equity NPV	1,781,153,214					

Figure (7) represents the project Cash flow (excel model)



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
EARNINGS	-	-0.24	-0.56	0.30	0.35	0.41	0.47	0.55	0.64	0.74	0.85	0.98	1.13	1.31	1.51	1.74	2.01	2.31	2.66	3.07	3.53	4.07
Operating Cash Flows	-	-0.24	-0.56	0.34	0.39	0.45	0.51	0.59	0.68	0.78	0.89	1.02	1.17	1.35	1.55	1.78	2.05	2.35	2.70	3.11	3.57	4.11
Net Cash Flow	-	-	-	0.14	0.19	0.25	0.31	0.39	0.48	0.58	0.69	0.88	1.17	1.35	1.55	1.78	2.05	2.35	2.70	3.11	3.57	4.11
Cash Flow to Equity Holder	-	-0.11	-0.31	0.14	0.19	0.25	0.31	0.39	0.48	0.58	0.69	0.88	1.17	1.35	1.55	1.78	2.05	2.35	2.70	3.11	3.57	4.11
EBIT	-	-0.24	-0.56	0.39	0.45	0.53	0.61	0.71	0.82	0.95	1.10	1.27	1.46	1.69	1.95	2.25	2.59	2.98	3.44	3.96	4.56	5.25

Figure (8) represents the graph of the project cashflow (excel model)

Chapter 5: Model Validation

1. Introduction

The model was validated using 9 cases of previous projects as costs and 3 cases as net cashflow. These projects were collected from data. Each one of these projects is described below along with the source of the data that was collected. For example, in the costs validation, some of them exist already while some of them do not such as October stadium, so they provide a good mix of actual and proposed stadiums. In each of these tables you can see the capacity listed as number of seats and the quality case, the country and whether it has a commercial, roof, parking or not as these items will raise the costs as per illustrated in the model before but at the same time revenues will increase.

In order to verify the dynamic model, we will analyze the costs of these 9 different stadiums worldwide and revenues of 3 different stadiums at their time and convert the value at the concerned time to the future time value which indicates the current year/time using NPV equation as in the excel model and compare it to the exact value at that time after considering the future value of today to make sure that percentage error is precise.

The tables below show the data of different stadiums getting their capacities and lists their quality case according to the different criteria like architectural shape of the stadium, amenities, seats quality, safety measures and fans engagement. Moreover, the tables below will acknowledge the availability of commercial, roof and parking areas. The tables will also identify the opening year of the stadium.

2. Costs Inputs

Table (8): represent inputs summary for costs validation analysis

Stadium	Country	Capacity	Quality	Land Cost	Debt	Commercial	Roof	Parking	Year
Air Defense	Egypt	40,000	Minimum	0	0.0%	No	No	Yes	2010
October	Egypt	45,000	Mean	0	40.0%	Yes	Yes	Yes	2015
Allianz	Germany	75,000	Mean	0	70.0%	No	Yes	Yes	2005
Maracanã	Brazil	78,000	Maximum	0	31.8%	No	Yes	Yes	2013
Arena da Amazônia	Brazil	44,300	Mean	0	0.0%	No	Yes	Yes	2013
Estadio Nacional	Brazil	71,412	Maximum	0	0.0%	No	Yes	Yes	2012
Stadion Jagiellonian	Poland	22,386	Mean	0	0.0%	No	Yes	Yes	2014
Hazza Bin Zayed Stadium	UAE	25,000	Maximum	0	0.0%	No	Yes	Yes	2013
Borj El Arab	Egypt	80,000	Minimum	0	0.0%	No	No	Yes	2007

3. Costs Outputs

Table (9): represent outputs summary for costs validation analysis

Stadiums	Capacity	Model Value (Local Currency)	Actual Value Today (Local Currency)	Error
Air Defense	40000	365,634,698	400,000,000	**-8.59%**
October	45000	3,041,276,897	3,029,187,393	**0.40%**
Allianz	75000	386,549,131	385,056,000	**0.39%**
Maracanã	78000	2,889,938,018	2,825,783,742	**2.27%**
Arena da Amazônia	44300	1,088,595,797	1,036,120,705	**5.06%**
Estadio Nacional	71412	2,450,780,893	2,427,406,657	**0.96%**
Stadion Jagiellonian	22386	284,859,390	283,948,082	**0.32%**
Hazza Bin Zayed Stadium	25000	722,157,400	772,879,354	**-6.56%**
Borj El Arab	80000	1,208,951,660	1,305,000,000	**-7.36%**

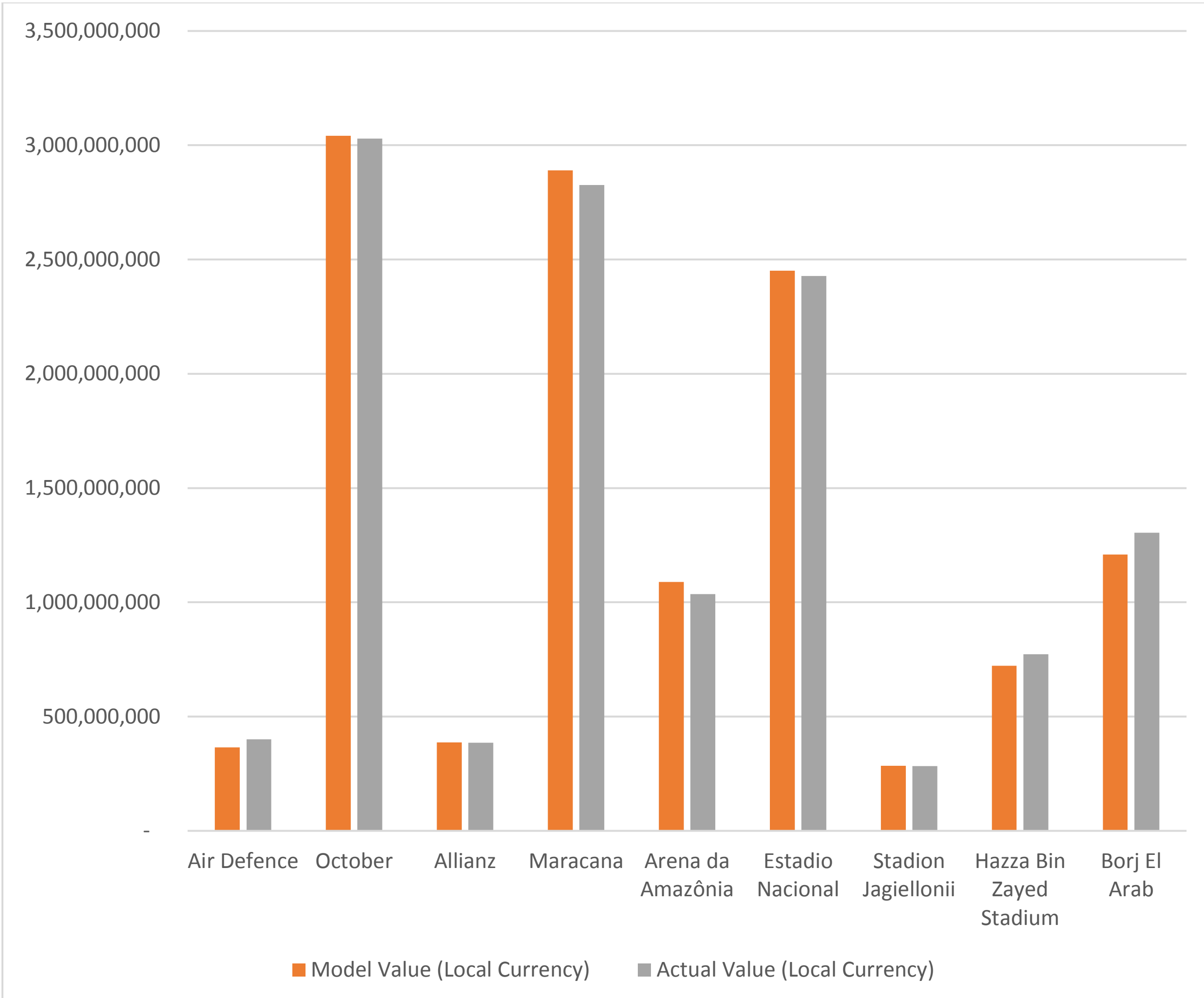


Figure (9): Chart illustrating costs validation analysis in local currency

4. Net Cashflow Inputs

Table (10): represent inputs summary for net cashflow validation analysis

Stadium	Country	Capacity	Average games per season	Team Tier	Quality	Land Cost per m2	Debt	Commercial	Roof	Parking	Year
Juventus	Italy	41,500	25	B	Mean	500	65.0%	No	Yes	Yes	2011
Wembley	Britain	90,000	15	A	Maximum	0	40.0%	Yes	Yes	Yes	2007
Allianz Arena	Germany	75,000	25	A	Maximum	1000	70.0%	No	Yes	Yes	2005

Land cost is added here to two stadiums while not added to Wembley as Wembley new stadium was done on the same land of the Wembley old stadium so land cost will not be included in the cashflow of the project as Juventus and Allianz Arena stadiums. Moreover, as Allianz and Juventus related to two sports teams' clubs so around 25 games per year played while in Wembley it is mainly used for only England national team so less number of games played per year around 15 games (Wembleystadium, 2017). While team tier as fans engagement to games reaches the peak to England national team and also for Bayern Munich sports team owner of Allianz while less fans engagement come to the Italian league and Juventus sports team which will be categorized as team tier B.

5. Net Cashflow Outputs

Table (11): represent outputs summary for net cashflow validation analysis

Stadiums	Capacity	Model Value (Local Currency)	Actual Value Today (Local Currency)	Error
Juventus	41,500	26,349,590	27,500,000	**-4.18**
Wembley	90,000	80,726,000	80,200,000	**0.66**
Allianz	75,000	43,279,000	52,077,621	**2.76**

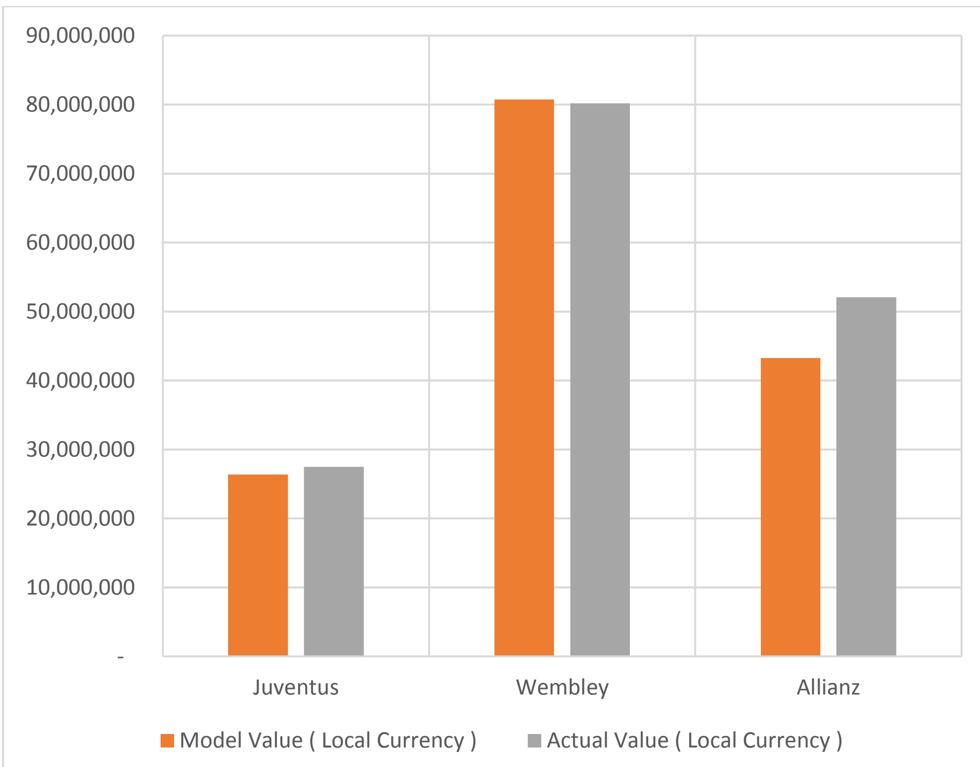


Figure 10: Chart illustrating Net Cashflow validation analysis in local currency

6. Stadiums Pictures

Figure (11) represents the Air Defense Stadium (Egyptian Ministry of Youths and Sports)

Figure (12) represents 6th of October Stadium (Egyptian Ministry of Youths and Sports)

Figure (13) represents Allianz Arena Stadium (WorldSocccer, 2014)

Figure (14) represents Maracana Stadium (www.designbuild-network.com/projects/maracana-stadium/, 2016)

Figure (15) represents Arena de Amazonia Stadium (Arena da Amazônia / gmp Architekten , 2017)

Figure (16) represents Estadio Nacional Stadium (Estadio Nacional de Brasilia, 2014)

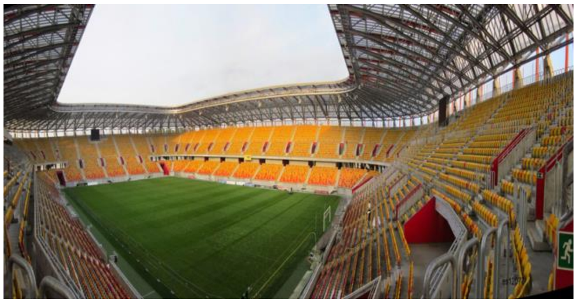


Figure (17) represents Stadion Jagiellonii Stadium (Stadion Miejski w Białymstoku (Stadion Jagiellonii, 2014)

Figure (18) represents Hazza Bin Zayed Stadium (Hazza Bin Zayed Stadium, 2014)

Figure (19) represents Borj El Arab Stadium (Egyptian Ministry of Youths and Sports)

Figure (20) represents Wembley Stadium (Wembleystadium, 2017)

Chapter 6: Parametric Analysis

1. Introduction

Here in this chapter a sensitivity analysis is done on the model. 4 different items are chosen one of them is how the roof existence will be sensitive in the model in terms of cost and IRR value. The same sensitivity analysis will be done on existence of commercial area in terms of both cost and IRR value. Knowing that analysis is done on different capacities from 20,000 to 80,000 represented on Egypt as a country with quality and revenue case of mean and A as team ranking / tier and estimated average games per season to be 30 noting that all costs in the charts and tables below are in terms of the local Egyptian currency.

2. Cost sensitivity (roof / capacity)

Variations in the stadium cost are plotted against the capacity with a commercial area existence in both cases. The roof is one of the important parameters that will affect cost of the stadium. In the table below, a variance in cost occurred for each different capacity varying from 20,000 to 80,000. The plot is shown in the chart below as linear somehow, but at the same time the difference in costs is not so far as percentage of roof cost to total stadium cost varies from only 8 % to 17 % as different capacities varies from 20,000 to 80,0000. That's why a gap in cost variance get bigger as capacity increases more as percentage increases more in this case.

Table (12) represents Cost Sensitivity (Roof/Capacity)

COST				
Roof/Capacity	20000	40000	60000	80000
Yes	1,695,517,452.18	2,648,461,977	4,228,565,467	4,453,300,201
No	1,592,511,846	2,450,260,657	3,801,111,465	3,998,878,031

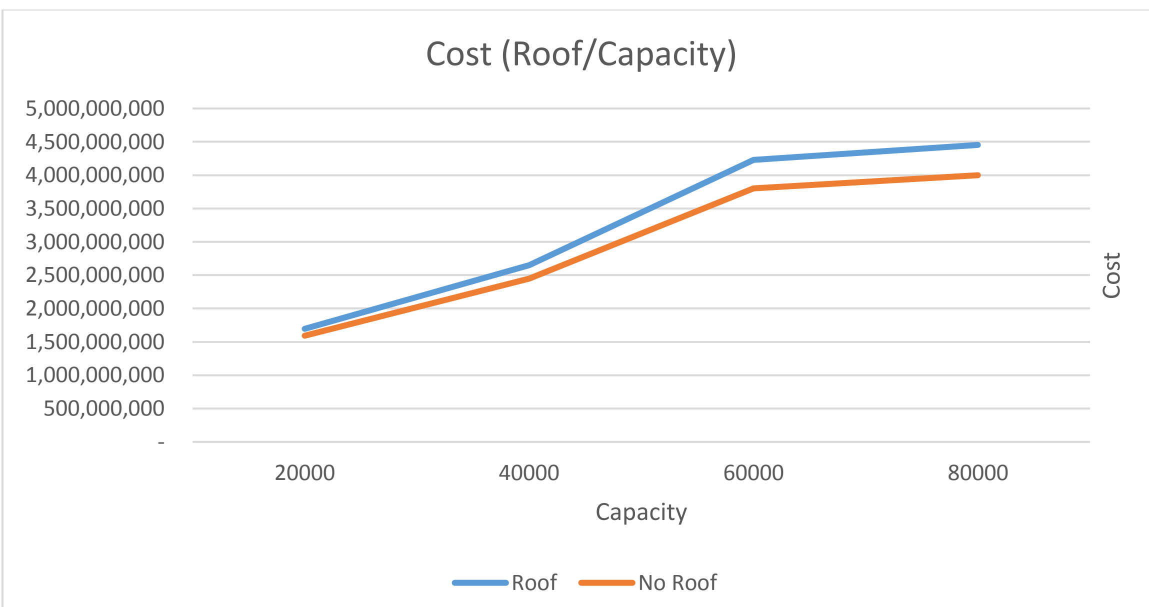


Figure (21): represents the cost (Roof/Capacity)

3. Cost Sensitivity (commercial / Capacity)

Versus to roof cost sensitivity, a big difference is shown and is obvious when it comes to commercial as commercial areas represent a large percentage due to extra land cost and construction costs in the different components of the commercial area. So, changes here are obvious and plotted due to different capacities of stadium from 20,000 to 80,000

Table (13): represents Cost Sensitivity (Com./Capacity)

COST				
Com/Capacity	20000	40000	60000	80000
Yes	1,695,517,452	2,648,461,977	4,228,565,467	4,453,300,201
No	1,030,056,063	1,982,013,198	3,562,116,688	3,786,851,422

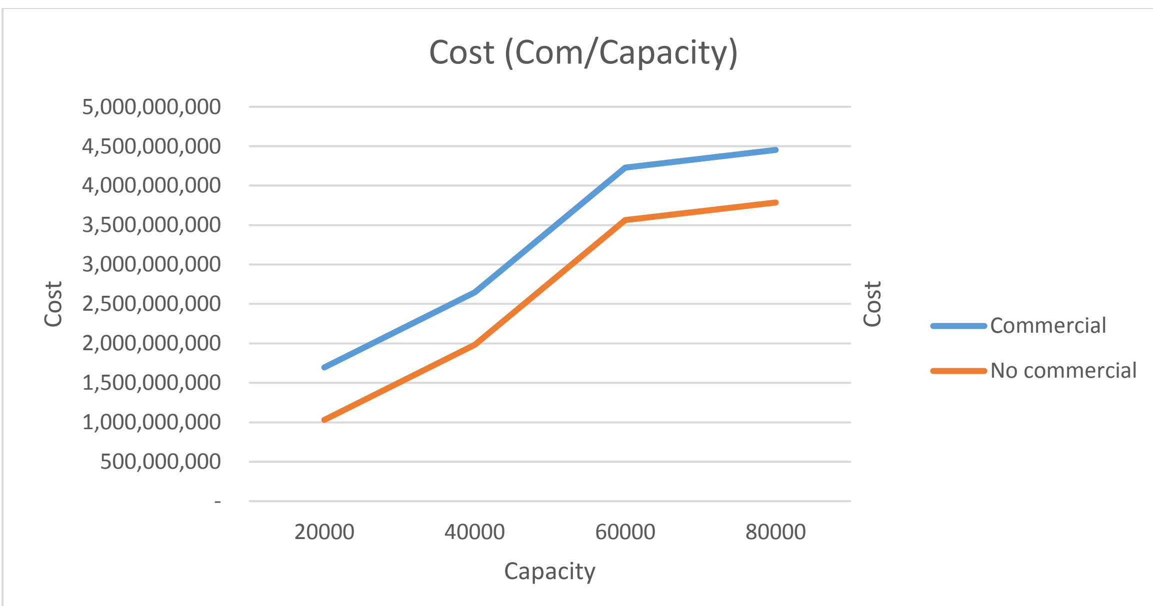


Figure (22) represents the Cost (Com/Capacity)

4. IRR sensitivity (roof / capacity)

Similar to what happened in cost sensitivity to roof / capacity; variations in the stadium IRR are plotted against the capacity. The roof is one of the important parameters that will affect IRR of the stadium. Again, in the table below a variance in IRR percentage was noted for each different capacity varying from 20,000 to 80,000. The plot is shown in the chart below is linear somehow but at the same time the difference in IRR between roof existence cases and non-existence cases are obvious as IRR decreases in the case there is a roof existence as that increase the cost stadium without changing anything in the revenues scheme of the project as the roof is not a profitable item so its existence will lead to lowering the IRR. However, a better IRR is noticed in 80,000 capacity type than 60,000 capacity type in both cases of roof existence or nonexistence.

Table (14): represents IRR Sensitivity (roof/Capacity)

IRR				
Roof/Capacity	20000	40000	60000	80000
Yes	54%	46%	38%	39%
No	56%	48%	40%	42%

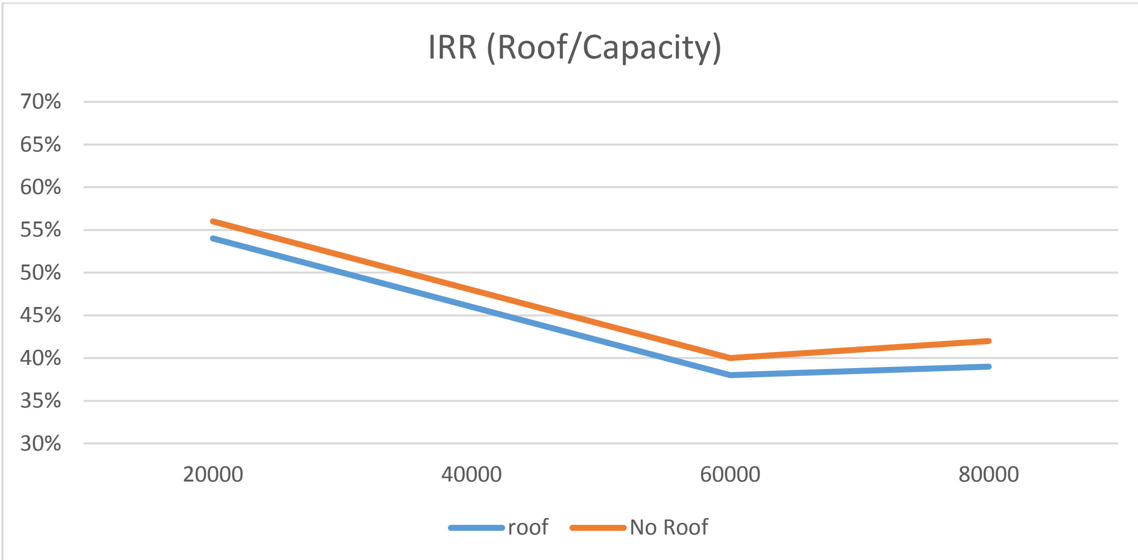


Figure (23) represents IRR (Roof/Capacity)

5. IRR sensitivity (commercial / capacity)

Changes happened to IRR Percentage in case there is a commercial area or not along different capacities from 20,000 to 80,000. IRR went higher at first in the case of there is a commercial area reaching 54 % at 20,000 capacity case compared to a noncommercial area with IRR reaching 51 %. Both are quite high and provide good results as costs of building 20,000 stadium are low comparable to other higher capacities.

However, IRR begins to go lower in the case of higher capacity increase to 40,000 till reaching 80,000. Analysis that can be get out of such change is that building a commercial area in the 20,000-capacity model would be a viable choice as IRR;

However, going to larger capacities will lead to a larger land area as for the total project which is directly proportionally to commercial area. Land size of commercial area will be greater which will lead to more costs later on and that's why IRR will be less in case of existence of a commercial area in comparison to non-existence of commercial areas in larger capacities except in the 80,000 model where the below chart indicates higher percentage in 80,000 case than 60,000 which gives an indication and guide for the owner/investor building a stadium in Egypt to go for the 80,000 capacity with or without commercial area as better than 60,000 capacity if thinking in high stadiums capacities while if thinking of low capacities 20,000 will be the best choice as a better IRR

Table (15): represents IRR Sensitivity (Com./Capacity)

IRR				
Com/Capacity	20000	40000	60000	80000
Yes	54%	46%	38%	39%
No	51%	41%	33%	35%

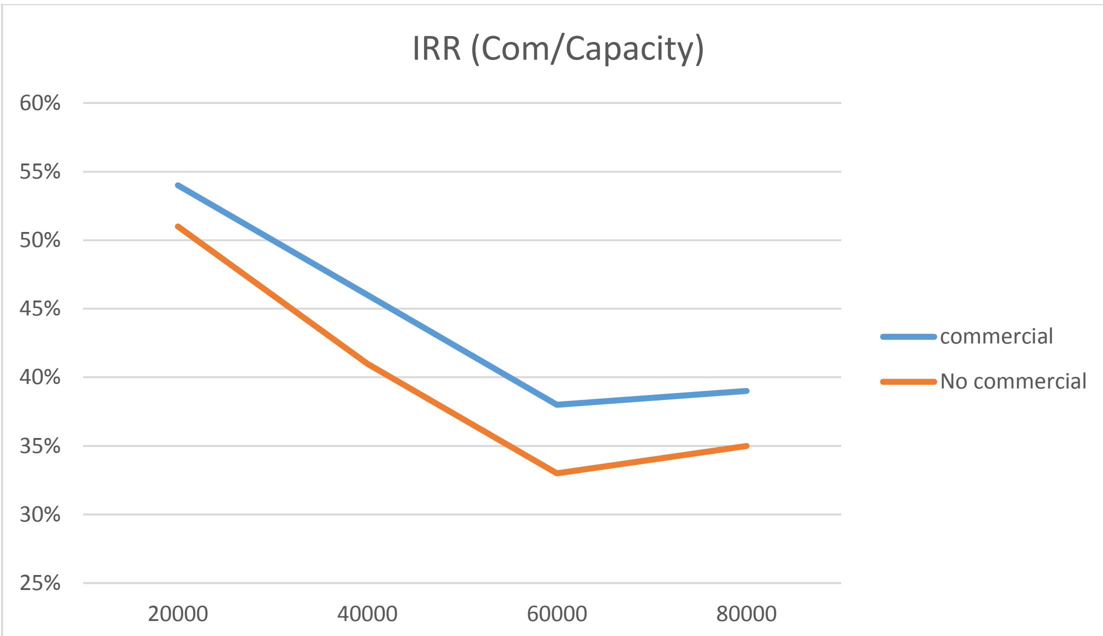


Figure (24) represents IRR (Com/Capacity)

Chapter 7: Conclusion

The research illustrates and guide owner/investor when it comes to the topic of building stadiums and how this is feasible and if it is viable or not. Many stadiums in Egypt lack the profitability vision of doing a successful project in the financial sense of matters. While some lack the international standards in construction of stadiums; others lack both. Here and exactly on chapters 3 and 4 a full detailed illustration is done on how to build stadiums taking into consideration all the proper aspects in zoning, circulation and safety measures according to FIFA technical recommendations and requirements. In chapter 4, a financial analysis is done on sources of different capital costs for building a stadium and different sources of revenues corresponding with the numbers and conditions of the international market

The model was chosen to be a dynamic model taking into consideration all the main and sub parameters that are parts of stadium execution process. The model is based on very simple and basic data that should be on the minds of any investor who wants to start a project like an international stadium. Having capacity, team tier, country and quality case in mind, the category of the team ranking a full data for CAPEX and revenues will be generated easily.

The currency exchange in dollars was measured for the 56 countries of the model representing countries having the Big Mac index. The NPV was implemented into consideration of building the stadium in USA today, tax rate, corridor rate and ticket price for each country. The Big Mac helps to identify all the indexes of the Big Mac for each country in the last 7 years starting 2010 till 2017 to know the purchasing power in each country as these were the data guide for use.

Validation that was done either on costs or on net cashflow refers to a very close percentage error including either CAPEX of the stadium when done on Maracana stadium in Brazil or net cashflow when done on Allianz Arena of Bayern Munich or other listed stadiums before as in Chapter 5.

Therefore, the model can be efficiently used with a very close to accuracy percentage of error. A quick feasibility analysis for a multi complex stadium construction viability in different 56 countries helps the owner/investor to take the decision of going on with project or not plus overseeing the future cash flow of the project.

Moreover, doing the parametric analysis was very important in testing the model changes as variance happen to numbers represented in cost or IRR. For example, IRR percentage is so sensitive when it comes to commercial areas existence or not as going to larger capacities will lead to a larger land area with regards to the total project. Due to the direct proportionality with commercial area, land size of commercial area will be greater which will lead to more infrastructure costs. That's why IRR will be greater in case of smaller capacities

An option of adding a roof, commercial area and parking is a core part for the model and the feasibility success of a stadium specifically for the commercial area. If the stadium becomes successful financially, the mixed-use vision should be added to maximize the profits as much as possible. As a result, a higher NPV is achieved and increases IRR.

The cash flow is then derived after adding all the parameters excluding land cost in this case however the model works for adding land cost if needed with the flexibility of adding the preferred payment method and instalments to the investor. As a result, net cash flow, operating cash flow, cash flow to equity holder, EBIT and earnings are sorted out as outputs. It seems that negative net cash flow usually appears in the first 3 years as construction period then begins to return to zero level at year 4 increasing slowly through years 5 to 8 then begin to go more rapidly as per chart done in cash flow part in chapter 4 and for sure as per the payback period.

Finally, I recommend future researchers for two things. First, working on same or similar topic to try sorting out a more accurate cost index benchmark rather than The Big Mac one as yes, it is a certified and a good benchmark between different countries but has some limitations as stated before in the literature review chapter which can result in some errors percentages in the validation part. Second, to try make the model broader as applied for all kinds of stadiums and sports facilities not only soccer stadiums.

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