University of New South Wales

GSOE9820 Engineering Project Management

Team 28

Project 4 – Case Study

Arup: Building the Water Cube

Final Report

Team members:

Hao Zhang (z5040867)

Jarrod Axe (z3462980)

Leonid Zhernakov (z5112495)

Zheng Pang (z5056298)

Sampat Shetty (z5132246)

Yu Liu (z5129030)

Yunhao Fu (z5103496)

Demonstrator: Sandra Cowan

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Executive Summary

In this group project, a case study relating to the process of designing and constructing the Water Cube is analysed. The Water Cube is a remarkable building, as a result of international collaboration. The innovative parts of this building are listed, as well as major accomplishments from different aspects. What' s more, Challenges would come out as it was a long-term, complex and international project. Proper management action was taken to deal with challenges, especially for the cultural difference. At the last part, reflection is made to make full use of this case study. Contributing practices from the document are highlighted, followed by deep analysis of the firm Arup. In addition to the specific characteristics, the important role of Arup is recognised and reported. Lessons Arup could learn is summarised to get insight of this project.

Introduction

Arup is the world' s leading design company which has decades of history. The firm has designed a lot of symbolic building with ground-breaking and innovative structure, including the Opera House, the Centre Pompidou and the Sydney Football Stadium.

In the early 1960s, Arup applied a debatable conception of multidisciplinary total design which gives equal weight to different disciplines. In the 1980s, the company paid more attention on efficiency, sustainable factors and the consuming of the energy. At the year of 1993, Arup, along with PTW, took part in the design of the Sydney International Aquatic Center for Olympic Game in 2000. As a result, Arup can be one of strong candidates and finally won the opportunity of designing the aquatics centre for the XXIX Olympic Game in Beijing in 2008.

The aim of the project is to analyse the Project of the Water Cube as a case study. Several aspects will be analysed, including the innovative components and the accomplishment of the Water Cube, challenges that the team faced during the design and constructive period, specific practices which leads to the success of this project, the role and the specific attribute Arup take and the lessons that the company can learn from the project of Water Cube.

1.A successful project: the Water Cube

1.1. Innovative parts of the Water Cube

These innovative aspects, which impresses members most, can be grouped into four categories.

1) material used in Water Cube

ETFE would provide a cost-effective solution to the greenhouse idea and its transparency would mean sufficient diffused daylight.

2) structure style designed for Water Cube

The architectural style of Water Cube reflected traditional culture. The Weaire-Phelan foam structure is the basic element for the building. Using Chinese symbols and Weaire-Phelan structures make Water Cube unique and innovative (Bila, R 2017).

3) the team which designed Water Cube

China invited the whole world to help build the water cube, by setting a competition.

4) Method used during designing

High-tech methods were used during designing, including the simulating method and ETFE technology.

1.2 Major accomplishments of the Water Cube

When evaluating the project, Arup used a method named Sustainable Project Appraisal Routine (SPeAR®) to demonstrate the characteristics of a project. That method will evaluate a project from four dimensions, that is, environment, social, natural resources and economic respectively. In light of this, we group the accomplishments under these four groups.

1) accomplishments relating environment

ETFE is environmental friendly and sustainable, storing sun’ s heat to heat the pool building and the water. Apart from that, conservation of water made high water efficiency by using recycled hot water.

2) accomplishments relating society

This project reflects the green and sustainable objective, as well as Chinese traditional concept yin/yang, in junction with the National Stadium.

3) accomplishments relating natural source

The design took significant advantage of solar power to reduce heating energy consumption.

4) accomplishments relating economy

Water cube was converted after Olympic and is designed to operate for at least 50 years.

In addition, the group members also come up with some accomplishments associated with successful utilization of hi-tech methods and efficient international collaboration.

5) Optimization of the building was successfully achieved by software which enabled team to work quickly.

6) Effective international collaboration and partnership within the consortium were achieved.

2. Challenges during the project

1) Competitive Environment

Because Beijing intends to build a world-class Aquatics venue, 33 companies which come from 12 countries participated in the competition of design and building the Aquatics Centre.

2) Limited budget and time

There are only $100million for constructing the Water Cube and another $10million to turn it into a leisure or commercial place after the Olympic Game.

3) Culture and background differences

Within the Arup team, there are specialists from different countries with various disciplines and languages. Besides, Chinese regulatory authorities hope that the

new Aquatics Centre can cater to both Olympic spirit and Chinese traditional culture.

4) Divergences during the concept phase

Obviously, there are two different ideas during this period: one supports a wave-shaped structure and another supports a square-based form. The divergence results in a tension and an anxious atmosphere in the design team.

5) Turning vision into reality

When the team got down to construction, they found a significant challenge. It is mentioned by Leslie-Carter that the conception had a large number of wow-factor. New technology and materials were so cutting-edged that many researches were still necessary.

6) Sustainable and efficiency challenges

The design team want to reduce the energy consumption for heating and artificial lighting so that the Water Cube should be ecological and able to sustain itself economically for 50 years. In addition, the lack of water and recycled system in Beijing is also a challenging issue.

7) Safety issues

According to the case, although the EFTE has many good characteristics as an ideal constructive material, it is highly combustible. The design team should convince the judges of the safety of this design (Eccles at el, 2010, p9).

8) Management issues

Firstly, it is challenging to create a safe environment for the staff. The second is the management of the interfaces with different departments. Finally, the regulatory transparency is not clear enough, different work methods, and relationship-based business culture in Beijing.

During discussion, our group members found that it is helpful to rate challenges and make some rank. The table below shows that which challenge is the most important challenge in their own mind and indicate their understanding.

Name	Challenge
Hao Zhang	Design challenges
Sampat Shetty	Sustainable and efficiency challenges
Leonid Zhernakov	Convincing Chinese government that ETFE meets safety standards (Safety issues)
Zheng Pang	Innovative thinking
Yunhao Fu	Communication challenges
Yu Liu	Divergences during the concept phase

3. Analysis of the project

3.1 Practices contributing to project success

The specific practices and processes, contributing to the team' s success, can be grouped into two main parts, in addition to the efforts to solve the challenge associated with culture difference.

1) proper management strategies, including 'total design' and an evaluating method SPeAR®

'Total design' concept aims to combine all the professional designs and engineering disciplines together. Additional, SPeAR has appeared as a very useful tool to provide evaluation of the level of sustainability and give recommendations for improvement.

2) Good use of resources, including the high-tech methods and building material.

ETFE could minimize the erosion effect caused by the sunlight. Hi-tech methods, like rapid prototyping and Building Information Modeling, make analysis and communication between members more clear.

3) Being active to cope with cultural difference

CCDI sent four architects to other firms in the team, in order to make

communication efficiently (Eccles at el, 2010, p3). Moreover, the other way to solve the problem is taking internal meetings in top management.

3.2 Role of Arup

1). 'Total Design' approach which includes multi-disciplines. The company can improve itself with the cooperation as well as competition between these professionals who come from different regions with different disciplines, and then make the creative vibrant, more comprehensive perspective.

2). A safe and comfortable working environment. It allows people with different habits work together at their own pace and make the best of them.

3). Appling every strategy which can make the work easier and better. For example, the application of BIM make the modeling process much more easier and faster than hand script.

4). The company is very willing to accept new ideas. When they working on a project, it is not just decided by one expert solely. They listen to different voices instead.

5). Arup always choose symbolic building with ground-breaking and innovation structure, such as the Opera House, the Centre Pompidou and the Sydney Football Stadium. It chooses high-quality and famous projects which can improve the company and is beneficial for future growth.

3.3 Specific Attributes of Arup

1). When there is conflict in the project, the team can deal with it perfectly instead of making decisions solely by one export. They can develop two designing process at the same time and make a competition.

2). The management team gave more freedom and autonomy so that everyone can work on their positions and do their jobs efficiently.

3). The total design aim to equal the disciplines, this will increase the corporation of the design as well as the knowledge.

4). The strategy of ‘interface management’ . The company divides the whole project into small parts called volumes. An interface occurred when the variable reach to the boundaries in terms of the time and physical.

5). It always tries to find new and effective solutions to conventional problems. For example, EFTE air penal, BIM, SPeAR etc.

3.4 lessons learnt from the Water Cube

1) One of the experience learn from the Arup company is that it gets familiar with the basic requirements for building in China, including official requirements and potential requirements.

On the one hand, Arup becomes familiar with Chinese cultural. It is necessary to consider the local traditional culture and combine it with their modern technology. On the other hand, Arup becomes familiar with the Chinese building code, which is provided officially and may not change frequently in a long period.

2) Arup learned how to achieve effective communication between firms with different backgrounds.

One important lesson that could be learned is that more collaboration and consistency were needed on the design stage. For example, utilizing the technology called the Building Information Modeling contribute to exchanging the information with the different staff. Also, using the total design concept is aimed to combine the different point of view together and optimize the results.

Conclusion

In this case study, we group 28 analysed the innovative parts of the Water Cube. We are impressed by its amazing structure which reflects the ‘green Olympic’ concept as well as traditional concept yin/yang. Apart from its outlook, the novel material ETFE makes contribution to achieving the energy-efficient system,

storing solar power and recycling water. However, there were several challenges faced by the whole design team. Among several difficulties, the cultural difference is the major problem, which led to a conflict between different firm in the team and required management strategies. Luckily, cultural difference was mitigated with project going. The important and contributing practices are analysed by group members to figure out the factors leading to success, including proper management methods, technical tools and active attitude to overcome the difference between countries. The function of Arup is stressed in the report and the wonderful parts of this firm are listed. The most useful lessons Arup could get from the project Water Cube are familiarity with building requirements in China and experience about communication between different firms, especially from different countries and cultures.

Reference

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