

MANAGING INTERNATIONAL PROJECTS: A CASE STUDY OF THE “WATER CUBE” AQUATIC CENTRE FOR BEIJING 2008 OLYMPIC GAMES

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This paper discusses the processes of managing the design of the Water Cube Aquatic Centre – a landmark building for the Beijing 2008 Olympic Games, including the project scope, project team, major challenges and lessons learned. It was found that innovatively meeting the client expectation and functional requirements, managing the organisational and national cultural risks and differences in the project team were the key issues leading to the project success. It is also found that China’s lack of regulatory transparency, regional difference, the need to protect intellectual property and copyright of design, as well as a relationship-based business culture were among the factors that made China a challenging project environment. Cultural understanding and relationship (*Guanxi*) building are fundamental strategies in responding to these challenges. One lesson learned was the need for the foreign design and management team’s involvement in the construction stage to ensure the conversion of design into reality, construction quality and personal fulfilment.

Keywords: cultural risks, China, innovation, international construction, project management.

INTRODUCTION

The Beijing 2008 Olympic Game provided a great opportunity for the international architecture, engineering and construction firms to demonstrate their ability in international design and project management. Considering the new technologies, new materials, and innovative design adopted in the Olympic projects, the complication of design and construction as well as the diversified culture background of the project team, there have been many challenges for design and construction of these projects. Hence many lessons can be learned from the successful projects. The Water Cube aquatic centre, as one of the landmark buildings for the Beijing 2008 Olympic Game, provided a number of successful project management practices and strategies which benefit the international construction projects in the future.

LITERATURE REVIEW

International construction project management in China

Generally speaking, project-oriented Joint Venture (JV) is one of the major entrance models of international companies (Paul, Lau and Nyaw 2007) for undertaking

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business in countries other than its motherhood. This is partly because of the specific political stability and macroeconomic conditions in the host country may significantly impact the project performance (Arditi and Birgonul 2007). Furthermore, the unique characteristics of each project are highly associated with JV performance and appropriate strategies should be developed to handle the particular risks and problems associated with the project (Ozorhon and Dikmen 2007). When focusing on international construction projects in China, the five most important factors leading to JV success are selection of partners, clear statement of JV agreement, obtaining information about potential partners, partner's objectives and control of the ownership of the capital (Gale and Luo 2003).

Ling *et al.* (2007a) suggested that to implement a superior project management practice in China, international construction companies should increase their financial strength to overcome the 'blank' period before making profit. International companies should also prepare high quality contract and project schedule as early as possible during the pre-contracting and planning stage. To control cost, time and quality issues during the construction stage, international firms should control language barrier risk to avoid misunderstanding, provide adequate equipment and employ qualified workmen. Further, Ling *et al.* (2007b) pointed out the importance of minimising claims or disputes in the contract, adequate provision of equipment to deliver the service, strong financial strength and management, controlling resources and cost overruns, appointing qualified and professional staff, good quality control and management plans, having more face to face communication than written communication. Likewise, Gunhan and Arditi (2005) stated that good track record, project management capability, broad international network, technology, material and equipment advantage are the most important strength of international construction companies.

In international construction project management, while companies have to face the threats from key employee losses, financial resources, international economy fluctuation, foreign competitions, cultural differences are also some of the major risks. Further, it is worth noting that project management in China is still immature. The main problems are located on the lack of qualified and experienced PM practitioners, conflict between client and PM companies, distorted competition in the PM market and the time of appointing PM companies (Liu, Shen and Li, 2003).

Cultural differences between China and the Western countries

When managing international projects in China, a particularly important factor that foreign firms need to face is how to manage the culture differences, especially for those companies with traditional western culture background. Different cultures may lead to significant differences in project management styles and capacities (Zwikael, Shimizu and Globerson 2005). Understanding the organisational and national culture, cross-cultural communication, negotiation and dispute resolution are considered to be the most important issues for project management in China, where personal relationships are very important and teamwork is preferred making decisions (Pheng and Leong 1999). One of the most important issues is *guanxi*, which refers to relationships or social connections based on mutual interests and benefits (Yang 1994). In general, *guanxi* and western relationship marketing do share some basic characteristics as mutual understanding, but they have quite different underlying mechanisms (Arias 1998). In contrast with relationship marketing, *guanxi* works at a personal level on the basis of friendship and affection is a measure of the level of

emotional commitment and the closeness of the parties involved (Wang 2005 and So and Walker 2006). When doing projects in China, developing an effective *guanxi* relationship with local Chinese partners is a key factor for most companies, in spite of the type and scope of projects. However, because of the complexity of *guanxi* relationship, some *guanxi* issues are more important than others for certain types of projects. For example, the external coalitions among *guanxi* partners which can contribute more resources to the firm survival are certainly more important than coalitions that contribute fewer resources. *Guanxi* strategies are also dynamic, changing along with business timing and location (Su, Mitchell and Sirgy 2006).

Previous research related to Beijing 2008 Olympics

There have been several studies related to Beijing 2008 Olympic Games projects. Sun *et al.* (2008) indentified and assessed safety risk factors inherent in Beijing Olympic venues construction, including the lack of emergency response plan and measures; workers' unsafe operation, and contractors ignoring safety under schedule pressure. The risk checklist, register, and assessment model developed by Sun *et al.* (2008) have been successfully adopted in two Olympic venue projects – the Beijing Shooting Range Hall (BSRH) and The National Swimming Centre (Water cube). Other studies, such as Kathy (2004) and Gareth (2005), analysed the Water Cube from the structure engineering and Architecture perspective.

AIM OF THIS RESEARCH

The above literature review revealed that while many studies on managing international projects in China have been carried out, none of them investigated in details a Olympic project in China managed by foreign firms. Though studies have been done for the Water Cube, none of them analysis the project from a project management perspective. This research used 'Water Cube' as a typical case of successful international complex project, to investigate the challenges faced by the Arup project management team and the project management practices that were adopted by the team to overcome the problems and to achieve the success.

PROJECT BACKGROUND

The Water Cube showcases both China's determination to establish itself as a leading destination for world sporting events. The requirements for Water Cube included a 50m competition pool, a 33m diving pool and a 50m warm up pool. The main pool hall was to have 17,000 seats and the whole facility had to accommodate everything required for an Olympic operational overlay. Following the games, the main pool hall was to be reduced to 7,000 seats with other facilities added in order to make the Aquatic Centre a viable long term legacy. The Beijing Municipal Government expects to successfully build the best Olympic swimming venue that would then become a popular and well-used leisure and training facility after the Games. It includes several criteria: (1) *Quality*: The best Olympic swimming venue representing the spirit of Beijing Olympics- "the green games, the hi-tech games, and the peoples' games". (2) *Cost*: no more than US\$100M before the Olympics and US\$10M for its conversion to legacy mode. (3) *Time*: The construction was to start before the end of 2003 and to be completed at least six months before the Olympics (i.e. 8 Aug 2008) to allow a sufficient period for trial competitive events. Figure 1 shows the Water Cube from its design imaginations to reality.



(a) The design vision (b) During construction (c) The constructed facility

Figure 1 Water Cube from vision to reality (Source: www.beijingolympicsfan.com)

Project team

The Water Cube has its project management roots in Australia. In 2003, a Sydney based team led by Arup, PTW Architects, and China Construction Design International (CCDI), won an international design competition, with 10 short-listed participants, judged by a panel of architects, engineers and pre-eminent Chinese academics. The Arup + PTW + CCDI Joint Venture design was selected as the clear winner from the competition both by the international jury and the people of China themselves. Arup's project managers led a team of more than 100 engineers and specialists, spread across 20 disciplines and four countries. Figure 2 shows the composition of the project team and members involved in the design and management of the Water Cube Project, with a particular focus on the personnel in the project management aspect. The design was delivered from competition stage through to a fully approved scheme in 12 weeks.

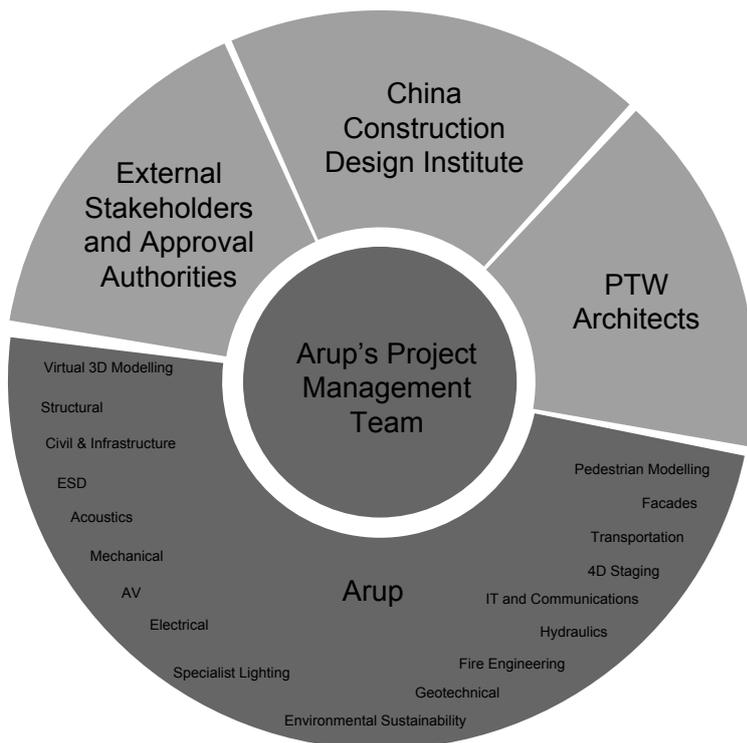


Figure 2 Project team for the Water Cube design and management

Project Challenges and strategies

The key threads of implementation strategy developed by Arup's project management team at the very start of the project cover everything from establishing a communication strategy, through to the dynamics of team leadership, a risk management strategy focused on the complex and dynamic nature of the Chinese market, and 'the management of difference' between Chinese and Australian

stakeholders. As well as delivering a fully coordinated scheme design, Arup's project managers had to seamlessly hand over the design to the Chinese design partners for detailing, whilst ensuring that the technical approvals were all secured, and that the innovative design was understood, accepted and then constructed safely. Ensuring the Water Cube became reality was only achievable by establishing and maintaining absolute clarity of the design vision, and full and transparent collaboration between Arup, PTW Architects, and CCDI.

Challenge 1 – The management of cultural differences risks

For the Water Cube project, how to manage communication both internally and externally, as well as how to handle the relationship with all parties involved in the project is critical to the success of the project. More challenging for Arup's project management team than the technical aspects of the Water Cube, and ultimately far more rewarding, was learning and understanding the business culture and context in China. It was not only 'foreign' to the team at the start of the project, but also highly difficult to read. As a follow up to the implementation plan workshops, Arup held some specific internal sessions with Chinese team members to agree on their approach to the 'management of difference'. This partly focussed on maintaining leverage over commercial arrangements, but mainly looked at how the team could minimise and manage the risks of the specific differences in norms, practices and expectations through the project lifecycle.

The complex and dynamic nature of the Chinese market, particularly in the context of the Olympics, meant that the risks associated with delivering the Water Cube could not be underestimated. Beijing's lacks of regulatory transparency, regional differences, as well as a relationship-based business culture were among the factors identified that made China a challenging project environment.

Arup's project management team looked at a diverse range of risks, trying to understand and plan their approach to the project in the unfamiliar context of China's legal, social, cultural, economical and technological environment. Other than the commercial risk of delayed payment, the key risks of the project were social – how China's business culture might affect the relationships and dynamics within the international Water Cube team, and with the external stakeholders involved in approving the design concept and detailing.

Social risks such as cultural misunderstandings could have completely derailed or significantly delayed the Water Cube project. Relationship building is fundamental in Chinese business, so understanding *Guanxi* – a form of social networking – and how to authentically cultivate and manage it was vital to the Arup project management team. The literature review in previous sections also addressed this issue (Yang 1994, So and Walker 2006 and Su *et al.* 2006). Other important factors in the approach included emphasising Arup's international reputation and the depth and diversity of our activities and locations. Arup also planned to ensure all their interactions with Chinese stakeholders involved giving them the highest possible quality of service, both in terms of the material and the Arup staff directly involved with them.

For example, well respected senior engineers from Arup's Beijing and Hong Kong offices were deliberately involved at key stages of the approach process. Their influence and local knowledge of the Chinese legislation, coupled with Arup's involvement in other high profile Olympic projects in Beijing, were leveraged to convince some conservative authorities to accept a range of innovative approaches to the engineering design that didn't follow the prescriptive rules of the Chinese Building

Codes. This was the number one risk in the early stages of the project, and the formal approval of the engineering design in early 2004 set a major precedent and direction for other Olympic projects.

Another good example was the commercial risks and their negotiations. For Arup, the project has been a financial success in that they made an acceptable profit despite the considerable risks of working on such a fast track project, with international partners and stakeholders, on a project involving such groundbreaking design techniques and materials. This is largely because Arup's specialist project managers were very specific during contract negotiations to clearly define its scope of services and the interfaces with the Chinese design partners, and were robust in contract negotiations that removed Arup from some of the post Olympic payment milestones that were unrelated to its scope.

By deliberately resolving any potential conflicts and risks early, Arup's team was able to sign a contract and facilitate a smooth and seamless handover to the Chinese partners with clearly understood and accepted interfaces.

Challenge 2 – Establishing a legacy

As the great cliché reads, there are only three things that matter when it comes to the Olympic Games, 'Legacy, Legacy, Legacy'. There were numerous legacy building opportunities that Arup's project management team initiated or facilitated during the project that directly benefitted the team relationship and the final outcome.

For Arup, an ongoing challenge during the contract negotiations was the inclusion of standard clauses to protect the intellectual property and copyright over design ideas and documentation. At the implementation plan workshop, Arup's project managers presented the benefits of embracing a very clear and simple policy that they collaborate with their Chinese design partners totally and with complete transparency. It was fundamental to establishing and maintaining trust and respect at the start of the project. In design terms, this involved accepting that the concepts and analytical approaches that Arup developed would become an important knowledge legacy to help their design partner develop their capabilities. In practical terms, it also meant that the handovers from Arup to CCDI were genuinely open and seamless.

Arup's project management team members spent a week interviewing ETFE tenderers and being challenged by a panel of Chinese academics on various aspects of the ETFE façade design and performance. As an extension to the deliberate legacy building approach, Arup lobbied that the ETFE contractors and the people of Beijing would benefit by investing in local manufacturing and processing facilities in Beijing, which the winning tenderer accepted and implemented. This guaranteed local training and employment in the short term, but also leaves a longer term local capability in producing an innovative material likely to feature heavily in Beijing's ongoing development program. Figure 3 shows the design details of the ETFE membrane roof for the Water Cube.

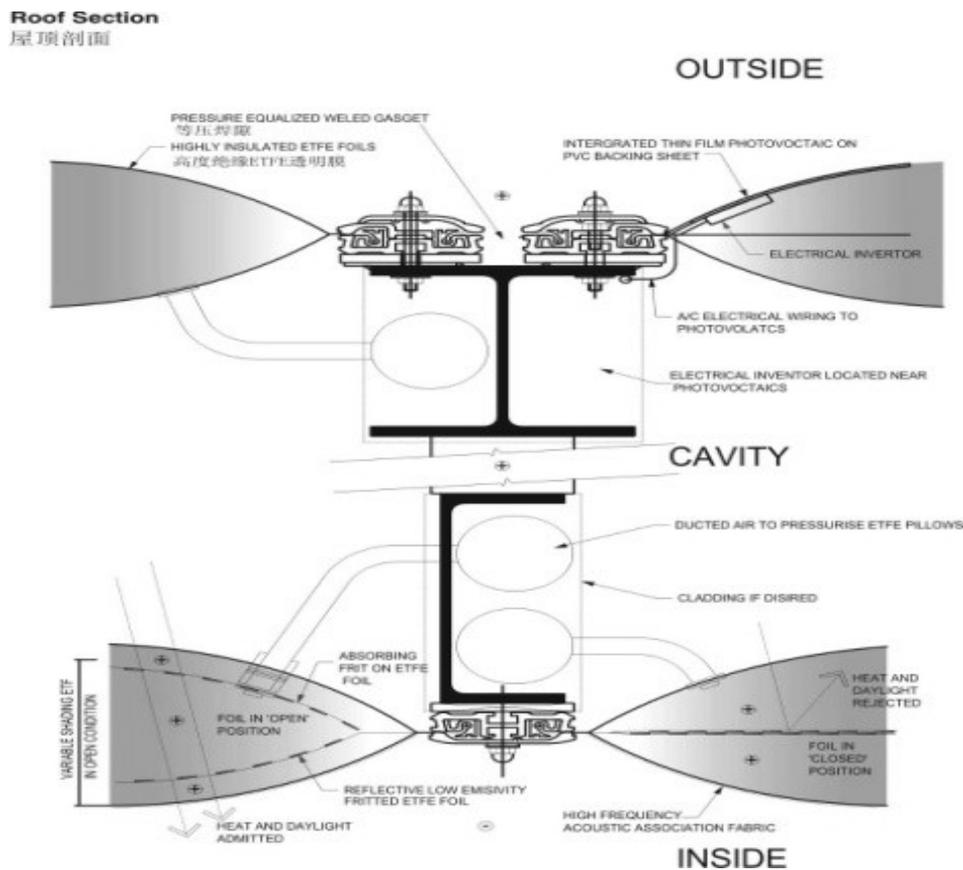


Figure 3 Design details of the ETFE roof

Another often debated legacy that Arup have always championed is the legacy of a totally shared ownership of the Water Cube concept. The philosophy of Arup's implementation plan workshop, and one that resonated with all stakeholders during the project, is that the box of bubbles concept for the Water Cube was generated by equally integrating the requirements of Arup's engineering, PTW's space planning, and Chinese cultural influences on architecture from CCDI. It was not the result of any one single dominant party. With such an iconic building, this was and remains a powerful statement in terms of the outstanding collaboration established between Arup, PTW Architects, and CCDI.

Finally, for the Arup project management team and the other team members involved, the relationships they have made, and the self fulfilment they have achieved from being part of such a wonderful project have provided a very genuine legacy. As well as achieving huge critical acclaim, the project has proved to be a successful investment in developing the project management approach to establishing and leading winning teams, managing relationships with stakeholders across cultures, project management processes required on major multidisciplinary projects, and technological improvements in the immersive 3D modelling capability. These have since been used to great effect on many other Arup projects.

Challenge 3 – complexity versus constructability

The budget for the Water Cube project was limited within US\$100M, while an equivalent Australian building would cost US\$500M. Therefore, to design a building for this budget is a remarkable feat. One key factor built into the design by Arup is its *constructability* - despite the building's apparent complexity and because the structure is based on a repetitive geometry, the sub-components repeat across the building. There

are only four different nodal geometries, three typical member lengths, and 22 different ETFE pillow shapes. This deliberate approach was driven by Arup's project management team and greatly reduced the time required for production and installation, and the fabrication and installation costs.

In addition, Arup's project management team led two days of workshops with key design team members to produce a roadmap for the project. Following an incredibly productive two days, the content of Water Cube implementation plan was approved, and was presented to the full Arup team the week before they officially commenced work on the concept design. Establishing these key project management strategies and their rapid and successful implementation were absolutely fundamental in shaping the success of the Water Cube. As a result, the Water Cube design was delivered as promised from competition stage through to a fully approved scheme in just 12 weeks. The fast-track program continued through to the official opening of the Water Cube in 2008 - on time, and on budget.

LESSONS LEARNED

Reflecting on the processes, several lessons may be learned. One aspect that could have been improved was being able to secure a role for Arup during the construction phase, and also post-Olympics for the conversion to legacy mode. During the *contract negotiations*, CCDI wanted to limit their overall fee bid by resourcing elements of the detailed design and site supervision locally from Beijing. Whilst Arup's project management team successfully managed to ring-fence their design role, their proposal to maintain even a skeleton supervisory role during construction to help ensure the design intent was achieved, was seen as an avoidable cost by the Chinese design partners. In some cases, particularly for the steelwork and ETFE façade, staff were sent to Beijing at Arup's own cost, but this became increasingly difficult as security measures tightened during the months leading up to the Water Cube's opening. The lack of involvement at construction stage had some implications on quality and also potentially unforeseen implications in terms of the level of ownership some Arup staff felt for the project.

Overall in terms of quality of the finished product, the Water Cube has delivered on the aspirations both internally and externally. The spaces are utterly uplifting and the 'box of bubbles' concept has already become one of the iconic structures of the 21st century. Some modifications to minor details were clearly decided on site, generally driven by changes to overlay and operator requirements. There are examples involved where these decisions have not been proposed, but they are not major and in fairness Arup was not party to all of the constraints that led to the solutions chosen.

Less tangible than the quality of construction details, was the potential effect on Arup staff being partially excluded from the construction stage activities. It's a fundamental part of projects that designers get enormous fulfilment from seeing the designs become reality. There is traditionally an ongoing role for engineers responding to site issues, attending coordination meeting with contractors, and being involved in final commissioning and handover. All of these are important parts of the ownership engineers ascribe to their work, and their motivation to be part of future teams.

The *internal communication strategy* Arup's project management team developed at the outset of the project was far reaching. It included engaging staff before and during the project through presentations, briefings, newsletters, regular celebrations of milestones, and small but very successful details such as email signatures with a

hyperlink to Water Cube information. However, there is still a gap between Arup's involvements in actually experiencing the Water Cube being built because it was only once the construction work had commenced and role diminished of the Arup team. The situation was highlighted even further by the geographical separation from Beijing, and the ever increasing levels of security and bureaucracy about site access.

To help promote staff involvement, close contacts were continually maintained with senior team members in CCDI who sent regular photos of the construction progress. These were circulated to all the Arup staff, and Arup held regular presentation of progress particularly when there had been an Arup visit. The effect was also reduced by the focus on the Water Cube concept by the media, with many of the staff giving lectures on the design, being featured in press and technical journals, and interviewed for programs such as MegaStructures on National Geographic Channel.

Ultimately in the case of the Water Cube – with its crystal clear design vision and high profile – Arup's lack of involvement during the construction stage did not have a significant negative effect on either the quality of the outcome, or the level of ownership amongst the design team.

CONCLUSIONS

This paper has discussed the key issues in managing the design process of the innovative Water Cube Aquatic Swimming centre for the Beijing 2008 Olympic Games. The main issues discussed include the project team formation and communication, key challenges, and lessons learned. It is found that the complex and dynamic nature of the Chinese market, China's lack of regulatory transparency, regional difference, the need to protect intellectual property and copyright of design, as well as a relationship-based business culture were among the factors that made China a challenging project environment. As such cultural understanding and relationship (*Guanxi*) building are fundamental strategies in responding to these challenges. Further, to establish a legacy for such unique international project, complex innovative design is necessary, in which, protection of intellectual property and copyright of such design should be considered. Yet, these innovative designs need to be traded off for constructability. One lesson learned from this project was the need for the design and management team's involvement in construction stage to ensure the conversion of design into reality and construction quality as well as the fulfilment of professional and personal satisfaction.

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