CASE STUDY
THE HONGKONG AND SHANGHAI BANK

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HONG KONG

EXECUTIVE SUMMARY

The purpose of this case study is to examine the unique project delivery method: semi design-build in which the architect takes the management lead.

Figure 1: Exterior view
Source: Jodijio

Project definition

owner:	Hongkong and Shanghai Banking Corporation (HSBC)
building use:	Bank's headquarters building
building type:	new construction (reconstruction of an old building)
size:	99,171 square meters (1,067,466 square feet)
construction cost:	£700 million/US$1,300 million[1] ($1,217/sf)
design-build firm:	Foster Associates, London, UK/Hong Kong
project delivery method:	design-bid-build (the architect took the lead in building)
design period:	June 1979 (request for proposals) – 1985
construction period:	1982 – 1985

In 1985, the new Hongkong and Shanghai Bank headquarters building was completed in Hong Kong. This new construction replaced the old building built fifty years earlier by the previous generation of the company. The 1935 building had professed to be the best architecture of the coming fifty years, so to continue that tradition, HSBC entrusted the Royal Institute of British Architects (RIBA) to conduct a request for proposals in June 1979. Out of six nominees, Foster Associates was selected on November 13 of the same year.

The architect had to face some key issues:

- managing his first project abroad,
- designing his first tall building,
- building in a colony with no indigenous heavy industry.

The Hongkong and Shanghai Bank building displays many technical innovations. The most important innovation, however, was not technical but methodological, what they called "design

[1] Source: http://campus.fortunecity.com/rice/1344/madeinhk.html

Shiro Matsushima, Doctor of Design, prepared this case under the supervision of Professor Spiro Pollalis as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

development."[2] Whether architects like it or not, modern building has become an industrial process. To cope with this situation, which is rather beyond the architect's control, one of the solutions is performance specifications. The architect simply states his/her requirements in a more or less detailed way and leaves it up to the product manufacturers and the subcontractors to fulfill them with ready-made designs or minor adaptations of the standard systems. However, Foster Associates had a different solution. They accepted the advance of industrial production; they accepted that it would no longer be possible for an architect to have complete knowledge of the technology of modern building; and they accepted that specialization was inevitable. However, they refused to accept the purely passive role implied by the performance specification procedure.

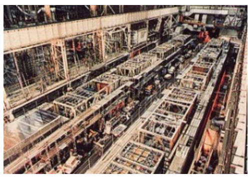

Figure 2:
Module assembly in Japan used a facility for huge electrical generators
Source: Lambot

This case study will examine the architect's attempt to control the entire process of design, production, and construction by uniting the architectural and the manufacturing processes. This is complemented by the episodes of collaborative effort between Foster's office, the structural engineer, and the cladding manufacturer ~~(which is currently working on the MIT Media Lab expansion)~~.

As architect, Foster Associates wished to remain in control because they alone had a unified conception of the complete building. Design development was their solution: a partnership between industry and architecture. The Hongkong and Shanghai Bank was a test-bed for this project delivery method.

PROJECT INITIATION

> "The project management structure should ensure maximum interaction between the Bank and design team—hopefully direct and personal."

In its submission in response to the request for proposals (RFP), Norman Foster made recommendations for the project management as well as for the integration of the internal office layout, color coordinations, finishes, and furniture design and selection as part of total design.[3] He also said, "Past experience has shown the value of direct and personal contact through key individuals between client and design team."[4]

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Figure 3:
HSBC Shanghai branch (now Shanghai Pudong Development Bank)
Source: http://isweb2.infoseek.co.jp

~~Edmund Sixsmith entered the portals of the RIBA at 66 Portland Place in April 1979. The subject on his mind was competitions; the man he wanted to see, now nearing the end of his term at RIBA president, was Gordon Graham. Sixsmith had been sent by Roy Munden who, as associate general manager, management service of The Hongkong and Shanghai Banking Corporation, had been delegated by its chairman, Michael Sandberg, to procure a new headquarters on its existing site at 1 Queen's Road Central. Sixsmith and his colleague John Scott from PA Management Consultants were hired by Munden to assemble a team of local consultants for a feasibility study. They began working in January 1979.~~

Palmer and Turner (P+T), the Hong Kong architects of the existing 1935 headquarters building,[5] joined the PA feasibility team along with Ove

[2] This is different from the design development phase in the ordinary design process.
[3] In terms of the cost, the originally quoted figure was for the shell only without these fittings-out, which is one of the major factors of the cost increase.
[4] This chapter is based on "A Project Diary" by Patrick Hannay in Lambot.
[5] They also designed the Bank's branch in Shanghai in 1923, one of the most preeminent buildings in the Bund. They were also in the short list of the request for proposals of this project.

Arup & Partners, service engineers J. Roger Preston & Partners, quantity surveyors Levett & Bailey, and property agents Jones Lang Wootton. The report was completed in March 1979 and PA was charged to assemble a short international list of architects for Munden to approach.[6] By June 1979, PA's feasibility study had become the basis for a 20-page request for proposals (with 50 pages for appendices). Although it recommended preferred strategies, the Bank was open to other solutions. The Bank intended to seek an architect, not a fixed solution. Sixsmith mentioned Foster's name to Munden. Graham agreed to include his name on the short list, but, alongside the track records for multistory headquarters for corporate owners of the other shortlist practices (Harry Seidler, SOM, Yuncken Freeman, Hugh Stubbins, P+T, and YRM), Foster was recognized by Graham, Sixsmith, and Munden as the wild card in the pack. The request for proposals document suggested that the quantity surveyors, structural engineer, and mechanical and electrical consultants of the feasibility study were to join the winning architect. The six shortlist practices arrived in Hong Kong on July 11 for a preliminary briefing and meeting with people. They flew home after a few days, while Foster's three-person team stayed three weeks, visiting frequently with Munden and other departments of the Bank.

The written and drawn submissions arrived by October 6. Graham and the Bank team, supported in some cases by the consultants for the feasibility study, carried out a comparative analysis of the submissions. One submission stood head and shoulders above the rest—Foster's. There was no need for a second interview.

The longest day

Foster gave a slide and model presentation of his proposals to the board on November 13. It was rumored to be the longest board meeting in the Bank's history. Chairman Sandberg was a banker. Several of the strongest board members were property magnates. The debate was tough. The chairman eventually achieved a unanimous decision. "Welcome aboard," said Sandberg.

Foster Associates set up a Hong Kong office in January 1980 in order to work through the details of the brief with the owner. Chris Seddon joined Foster Associates' Hong Kong office in February 1980.[7] He later became the chief client liaison member of the Foster team. In August 1980, the chairman of the board of the Bank saw a preliminary version of the final scheme for the first time. The reaction was positive, and as the time approached when the final scheme would be put before the main board the mood in Foster's office was one of quiet confidence. One reason for this was that, in pure real estate terms, the building represented excellent value for money. The area of usable floor was the maximum that could possibly be accommodated on the site. Foster beat the property men at their own game and, in the process, produced not a dull speculator's tower but a revolutionary work of architecture.

In January 1981, the scheme was presented to the board, which was suitably impressed and duly gave its approval. There was no going back now; it was going to be built. With the prospect of elements being fabricated all around the world and with critical design, development, and production periods required to meet the November 1985 completion date, there were intense discussions in London and Hong Kong about coordination.

DESIGN-BUILD BY ARCHITECT

The building was built by the design-build project delivery system. However, it was not a conventional contract where the contractor was awarded the main contract for the project and

[6] The good news for the team was that the selection process for the Lloyd's project, then under way in London, had been a success. Gordon Graham was seen as its author and was naturally one source of advice for the short list. Graham was involved in the project, first as architectural advisor for the RFP, as the Bank's paid architect after his RIBA presidential term ended, and later as Foster's consultant in January 1981. He again jointed the owner's board Project Policy Control Committee (PPCC), which was formed when the Bank encountered the US$ 50 million cost overrun for the steel work, in November 1982.

[7] Chris Seddon was also a project manager of Foster Associates for the Century Tower project in Tokyo, which followed this project.

Foster Associates undertook design work. It was instead a design-build project by Norman Foster. He undertook the project understanding the owner's requirement: the new building would have to be the highest in quality both in name and reality for fifty years. This meant that Foster should achieve the highest quality of architecture reinforced with innovative construction methods and development of materials and components, which was called design development methodology. In order to accomplish this lofty demand, Foster knew he must employ the design-build method.

In a conventional contract, the cost of construction is defined based on the estimate and the contractor is responsible for its profit and loss within the contracted cost. This contract, however, was more of a cost reimbursement system. Eventually, the cost increased from the original US$500 million to US$1,300 million when it was completed.

His system to manage the construction was to hire construction staff from the management contractor using his design fee and then build up an organization integrating architects, engineers, and construction staff. According to Shozo Baba, architectural critic, the members involved at the highest stage of construction consisted of 130 people from Foster's office; 80 from J. Roger Preston & Partners, mechanical and electrical engineers; 75 from Ove Arup & Partners; and 180 from a management contractor that was a joint venture of John Lok of Hong Kong and Wimpey's Special Project Unit (now Wimpey Construction Management) of the UK. Of those 180, 71 were from the UK.

For each building package, the construction management team selected the most appropriate subcontractor from around the globe; they made them build each component in their local factory and then imported them to Hong Kong. About one hundred and ten separate contracts were placed in Europe, North America, and Japan (about 20 countries in all). People from John Lok/Wimpey undertook the job of procuring, coordinating, programming, and monitoring the contracts, not just on site in Hong Kong but also in far-flung factories, workshops, and design offices.

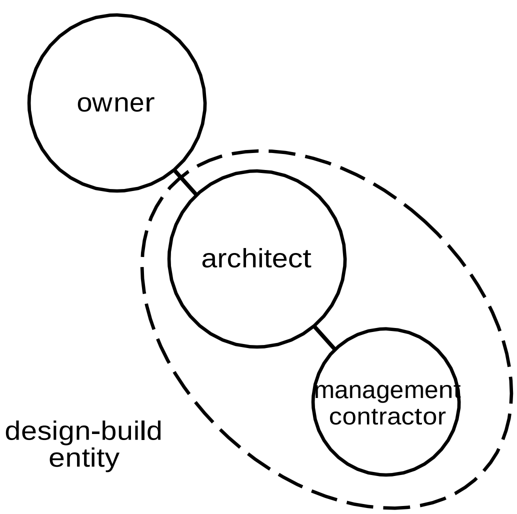


Figure 4: Design delivery diagram

Once all the components were in place, the construction management company had to begin the complicated yet standard task of assembling them. The level of a generic task was much higher for this project than for an ordinary project. In an ordinary project the construction management company is typically more concerned about procuring the cheapest product if the quality is the same, in order to maximize profit. For this project, however, Foster's organization placed more emphasis on the quality of the product than the price of it. Almost every important element of the building had to be researched, developed, and tested as if it were an airplane or a racing car. In addition, the results of the research and development program could not be described in advance and, given the limited time available, it was necessary for the design and construction phases of the project to overlap, which necessitated professional management more than conventional building skills. Therefore, Foster decided to have the construction management personnel under his direct control.

The fee for the enterprise was eventually 17.9% of the construction cost, which was about US$230 million. The total amount of the fee was capped in the middle of the project. Although the fee was relatively high compared with a generic contract (where it is about 10% of the total cost), people involved felt it was not sufficient because design development methodology consumed more money than anticipated. Of course, the fee included personal expenses for those from John

Lok/Wimpey, and the total number of people involved in the design entity was more than ten times that of a conventional design entity.

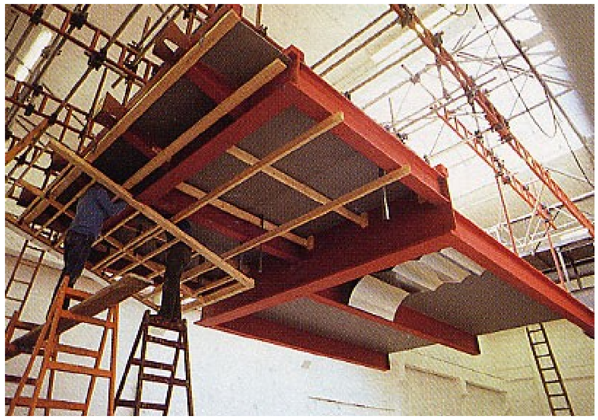


Figure 5: Full-size mock-up of a section of typical office floor was installed in Foster Associates' own workshop
Source: Lambot

COLLABORATIVE DESIGN—MULTIPLE EXPERTISE

Figure 6:
prototype of
see-through escalator
Source: Lambot

Almost every important element of the building was designed and developed from scratch in collaboration with factory-based specialists. The process involved much more than the usual cozy chats over the drafting board with technical representatives. Each element was the subject of a research and development program. Mock-ups and prototypes were built, tested, altered, and tested again until their performance and quality met with the architect's approval.

The steel suspension structure, plug-in pods, underfloor services, thoroughgoing prefabrication, and ground-level public plaza were designed with fung shui in mind: almost nothing in the design could be described as "conventional" or "tried and tested." In addition, there were the constraints that the building was to be built in a colony without indigenous heavy industry so that everything had to be shipped in; that Foster's office had never worked outside the UK; and that this was their first tall building. It was no doubt a great comfort to know that Ove Arup & Partners, one of the largest engineering practices in the world, was on the team. However, it was a daring proposal, and for many architects its realization would have been a frightening prospect.

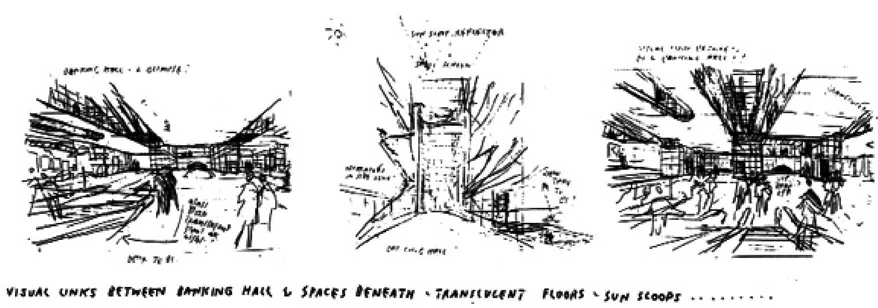


Figure 7: architect's sketches of innovative ideas
Source: Futagawa

Structure[8]

The building has a structure more like that of a bridge than an office building. The fabrication and erection of its steel frame was never going to be a routine matter. When Ove Arup & Partners had finalized their conceptual design, there was still a great deal of development work to be done on the various elements of the structure, and for this it was necessary to involve the steelwork manufacturer, making use of its technical expertise and testing facilities. A design development element was therefore included in the contract.

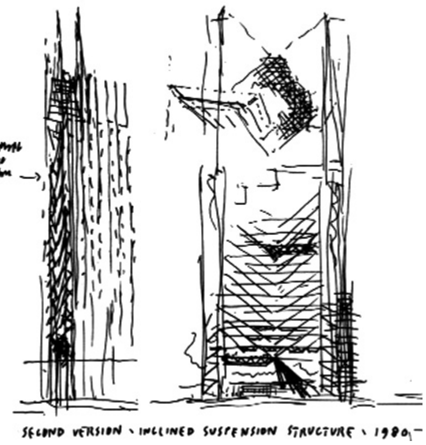


Figure 8: Foster's sketch of suspension structure
Source: Futagawa

There were a numbers of special problems, the solution to which required great ingenuity and inventiveness. In most cases, the conventional solutions simply did not apply. The tolerance was one of the critical issues for this building, whereas it is rarely crucial and a frame can be inaccurate to a degree in purely structural terms. However, in this design, packages such as the frame cladding, the external walling, the floors, and the service modules have much more demanding standards for accuracy. Since each element was a separate production package involving a high degree of prefabrication, tolerance became critical. There was precious little room, or time, to make adjustments during construction. When the components arrived on site, they had to fit perfectly. In addition, the building is unevenly loaded because of its uneven setback on both sides. Moreover, there was another complication: the structure was subject to much more movement than would be normal in a building of this kind. To study theses movements, special wind tunnel test were carried out at the University of Western Ontario. The design team came up with the idea of masts that are Vierendeel structures consisting of four circular columns connected by haunched rectangular beams at story height intervals. Another issue was connection. The dynamic nature of the structure meant that loads could not be relied upon to act only in one direction. Conventional pin connection would be liable to shift from one position to another as the loads reversed, which would cause worrying noise know as the "clunk-click" problem. The solution that eventually emerged was a typical example of technology transfer in the form of a component normally used in large-scale machinery and known as a spherical plane bearing. More than 650 of these bearings were used in the final structure, varying in diameter from 150mm to 600mm.

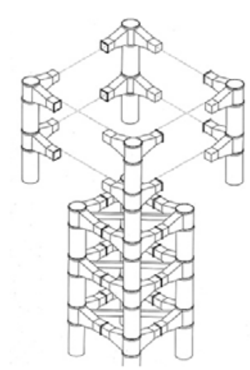


Figure 9:
Vierendeel mast
Source: Lambot

Figure 1:0
protection applied
Source: Lambot

[8] The following two parts are based on the articles by Colin Davies in Lambot.

Another issue was corrosion protection. Because the steel frame would be clad with aluminum skin, inside the skin it would be constantly damp. Therefore, the corrosion protection had to be both effective and completely reliable. Several options were considered including air-conditioning the cavity, which was rejected because of cost, complexity, and ineffectiveness. The next was encasing the steel in concrete. Although it would work as an effective barrier and also increase alkalinity, standard practice called for a minimum 50mm thickness of concrete, which would increase the load of the structure and visual heaviness. The answer was a completely new process called cementitious barrier coating (CBC). By applying special ingredients to a cement mixture, it was found that the required thickness of the coating could be reduced from 50mm to 12mm. In addition, high humidity in the cavity increased the chemical effectiveness of the protection.

The steel frame of the building is therefore innovative in all aspects from conceptual design to corrosion protection. Like every other major element of the building, it is the result of an intensive research, development, and testing program carried out by designers and manufacturers working together. While this may be normal for most industries, the adoption of this approach for use in building construction has been revolutionary.

Cladding

The design of the building is simple in terms of its plan, section, structure, mechanical service, and circulation system: ingenious and innovative, but essentially simple. The final three-dimensional form, however, is extremely complex. Cladding this form, keeping out the wind and rain and protecting its various components, was never going to be a straightforward business. Clearly, this is not the sort of building that can simply be sheathed in standard curtain wall. Exposed structural parts mean many penetrations and junctions of the parts and other building elements such as glass. In addition, a tension structure is much more mobile than a conventional compression system. Therefore, the painstaking process of design development and prototype testing was not just theoretically desirable but an absolute practical necessity.

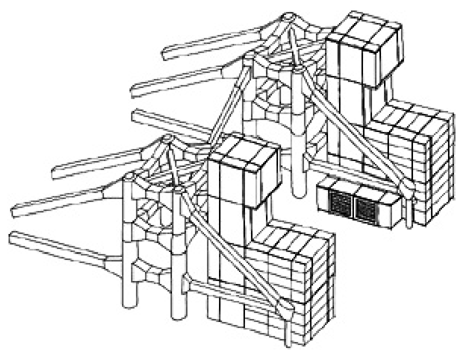


Figure 11: Cladding: simple but complex
Source: Lambot

Most of the cladding was fabricated and erected by Cupples Products, the St. Louis-based cladding subsidiary of H.H. Robertson & Company.[9] Cupples was appointed at an early stage following a worldwide survey of possible contractors, and was closely involved with the conceptual as well as the detailed design. It was the only firm to demonstrate the necessary commitment to quality and innovation, and a positive attitude to the concept of design development in collaboration with the architect. Close design development with the full support of an expert manufacturer was essential. A survey of leading companies identified Cupples Products as by far the most experienced[10] and, with the Bank's agreement, they were directly appointed as early as May 1981. Philip Bonzon,[11] the company's senior designer, led the team from Cupples, who were to work closely with Foster Associates over the next three years. His free-hand drawings demonstrate his

Figure 12: cladding model
Source: Lambot

[9] Cupples is now Cupples/Harmon, part of Enclos Corporation.
[10] Cupples' projects include the World Trade Center in New York, John Hancock in Chicago, and Sears Tower in Chicago.
[11] He is also a designer for the MIT Media Lab expansion.

unique understanding of the aesthetic as well as the technical considerations that were to play an important part in the successful design and manufacturing of the cladding.

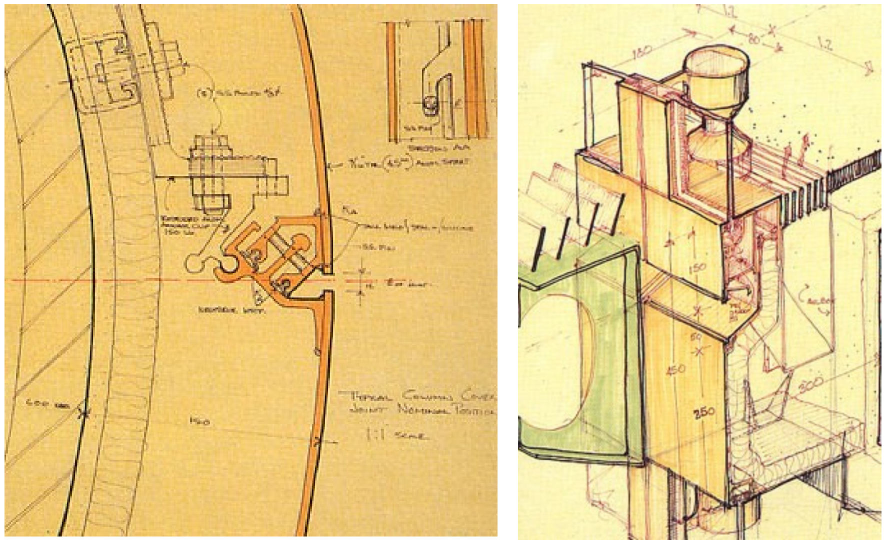


Figure 13: Sketches by Philip Bonzon: his free-hand sketch well conveys his understanding of the aesthetic, which is well shared with others
Source: Lambot

It was a collaboration that was eventually to produce a mountain of design information to be checked and double-checked on both side of the Atlantic. Cladding contractors usually have well-established design offices to develop their standard systems and adapt them for specific applications. This, however, was a development program of quite a different nature. All the systems were designed from scratch; they had to be able to cope with the unique performance requirements and ruthless rigor of the Foster design ethos. More than 2,500 sketch assembly drawings were prepared by Foster's design team, and these called forth no less than 10,000 shop drawings from Cupples. Cupples' designers made frequent extended visits to London to advise on detailed design, and a team of architects was stationed in St. Louis to oversee the design, testing, and manufacturing operation. As the design developed, large-scale models were prepared on which the implications of the joint and setting-out geometries could be accurately tested. At all items, visual considerations had to be balanced with an understanding of production and erection procedures. Prototypes were made of all major joints and junctions and tested for water-tightness under typhoon conditions simulated by the retired Second World War US Navy fighter, Corsair.

Figure 14:
Weather testing at Cupples' plant in St. Louis Source: Lambot

"The sheer visual delight of the cladding details on the Bank could not have happened without a shared endeavor, enthusiasm, and dedication which extended from a factory in Missouri, through to a Chinese workforce on site, and a highly mobile design team who were as much at home on the shop floor as on the drawing board. It is as much about aesthetics as water penetration and tolerances, but it is not about the architect [sic] as a remote aesthetics removed from the production process."[12]

[12] Norman Foster quoted in L'Architecture d'Aujourd'hui, February 1986.

CONCLUSION

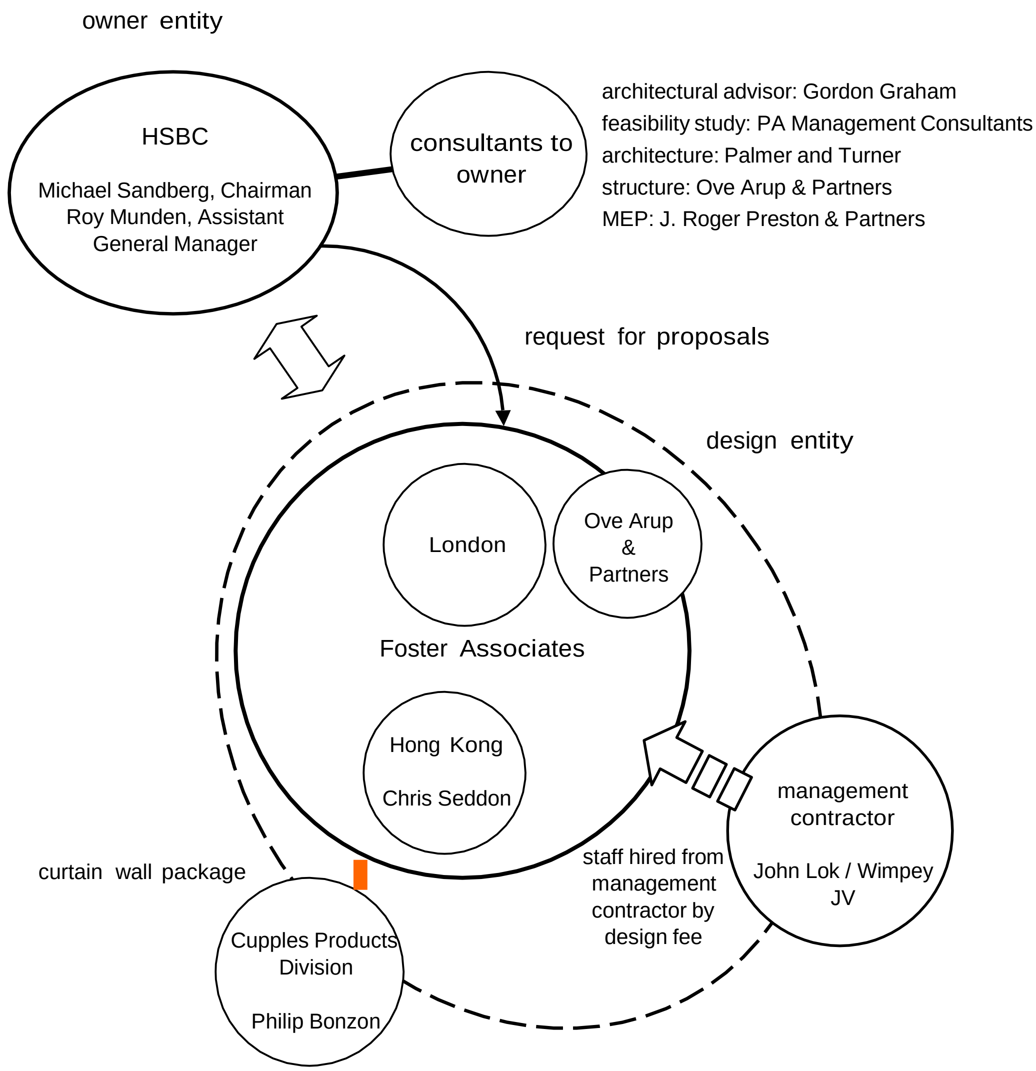
This case study focuses on the project delivery system in which the architect took the management role in the entire process, and on the collaborative process they called design development methodology.

Through the collaborative process with manufacturing specialists, the architects gained an insight into the possibilities offered by advanced industrial production methods, which are something almost entirely absent from their training, while the manufacturers had the benefit of the architects' innovation and global view of the project. One thing is very clear from the results of this process: the technical innovations displayed in the building could not have been arrived at either by architects or manufacturers working separately. The partnership was the crucial factor—a reuniting of the architect with the tools of building.

The design-build system tested by Foster's office is a very particular case because there have been essentially no followers since then. However, it is noteworthy because they tested the system for the purpose of achieving the quality of architecture and guaranteeing it. Not to mention its design: in light of developing a new perspective on architectural design, there is still high value placed on the Hongkong and Shanghai Bank in the history of architectural design. In addition, architects should not forget Foster's daring spirit, which took economic risks and all possible measures to ensure the success of this project.

Figure 15: Rich filigree and fine detailing of the elements
Source: Lambot

EXHIBIT A—PROJECT DELIVERY SYSTEM



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