The development of integrated solutions in construction: towards better value for the clients?

Frédéric Bougrain[1], Kim Haugbølle, Marianne Forman and Stefan Gottlieb[2]

Abstract Title

In construction project firms are moving into new kinds of value-added activities. This move is explained by the place of the housing stock and the growing demand for packaged product and service delivery. Integrated solutions are not dominant in construction which is characterised by the separation between design, construction and operation activities. The aim of this paper is twofold: 1/ to explore how relations are conducted between the integrated solution providers and the client during the construction and the operation of the building. 2/ to identify whether the development of integrated solutions in construction improves the quality of the process and stimulates innovation.

To deal with these issues, the paper will present two projects in Denmark and France. Both projects will be considered as complex and unique. Before developing the case studies, the paper will define the conceptual framework and the notion of complex products and systems (CoPS). Delivering CoPS projects requires the combination of project management capabilities and systems integration capabilities.

Keywords: Complex products and systems, integrated solutions, contracts, complex performance, construction system.

1. Introduction

Construction is actually facing several challenges:

- Construction is moving from the building activity to the service provided by the built environment (Carassus, 2002). As in other sectors construction firms are modifying their business model. They are moving into new kinds of value-added activities (AEGIS, 1999) and are becoming providers of integrated solutions. "*Integrated solutions involve the bringing together of products and services in order to address a customer's particular business or operational requirements*" (Brady and al., 2005, p.172). This move is explained by the place of the housing stock which is growing in importance in comparison with new construction. Moreover public authorities are

[1] Researcher; CSTB – University Paris Est, Pst Descartes – Bâtiment « Le Bienvenüe » 14 Boulevard Isaac Newton - 77420 Champs-sur-Marne - France; frederic.bougrain@cstb.fr
[2] Researchers, Danish Building Research Institute, Aalborg University, A.C. Meyers Vænge 15 2450 Copenhagen SV – Denmark; khh@sbi.aau.dk; maf@sbi.aau.dk; stg@sbi.aau.dk

more and more demanding for packaged product and service delivery. Finally, whereas margins are shrinking in construction, the provision of services offers continuous revenue stream.

- Construction is also shifting toward a performance based model. This is mainly due to a change of procurement. Traditional design and build contracts based on input specifications are more and more replaced by service-led contracts where the output to be delivered is specified (Hoezen and al., 2010). It also means that the scope of the contract goes further than design and build and encompasses operation and maintenance. Under this scheme a comprehensive performance measurement system containing key performance indicators often becomes the backbone of operational management.

Integrated solutions are not dominant in construction which is frequently characterised by the separation between design, construction and operation activities. However the development of new procurement process such as Public Private Partnerships (PPP) has contributed to the development of such solutions. Under this scheme, design, build, finance and operation are transferred to private sector partners. It is a way to deliver integrated solutions to public authorities. Fees are paid by the public authority to cover finance, construction and operating costs. Payments are made according to the quality of the service delivery which is judged on performance indicators. For public clients, the rationale of these projects is to deliver a enhanced service to its customers.

The aim is to explore whether this move towards integrated solution provision based on performance measurement system, provide better value for the clients.

To answer to this question the paper aims to scrutinize two different configurations, PPP and conventional procurement based on performance criteria. The projects will be located in different countries: Denmark and France. One will be in operation while the other is still at the construction stage. Both projects will be considered as complex and unique. The relationships between the integrated solution providers and the client during the construction and the operation of the building will be analysed.

Before developing the case studies, the paper will highlight how integrated solutions can be delivered in the Danish and the French construction systems. Then it will define the conceptual framework and the notions of complexity and complex products and systems (CoPS). Governance issues for the delivery of CoPS will also be examined.

2. The delivery of integrated solutions in construction: regulatory aspects

2.1 The French construction system

France has a long experience in private finance procurement. It concerns mainly infrastructure projects such as a road. In this system public authorities grant specific rights to a private partner to construct, maintain and operate the infrastructure for a given period. The

private partner operates the service at its own risk and is remunerated in the form of a price paid by the users of the service. Thanks to this experience French companies working on this market have developed strong capabilities to design and construct roads but mainly to operate, maintain and finance the infrastructure during its life cycle.

Only a limited number of assets such as buildings (hospitals, schools, prisons, stadiums…) were delivered under this form of procurement. Indeed according the law n°85.704 laid down the 12th of July 1985, the public client generally establishes two different contracts with the architect and the contractor. Design, build and operate (DBO) is possible but the client has to demonstrate that it is less expensive or technically necessary. However finance cannot be transferred to the private partner like for concession.[3]

The law passed in June 2004, proposed a complementary framework. It introduced the partnership contract ("Contrat de partenariat"). Under this new scheme, design, build, finance and operation are transferred to private sector partners. The partnership contract became the most used PPP contract. At the end of February 2013, 171 contracts were signed. About 33% of them deal with public lighting.

2.2 The Danish construction system

The construction market for refurbishment in Denmark is by and large of the same size as the market for new buildings. The main actors of the building process are the construction client, consultants, contractors and suppliers (Levring & Bonke, 1996). The Danish building process shares many of the same characteristics as the professional system in UK dominated by the consultants, which is quite different from the French industrialised system where the contractors are more dominant (Winch & Campagnac, 1995; Winch, 2000).

The typical procurement protocols are traditional (or trade) contracting, main (or general) contracting and design-build contracting. In recent years, integrated delivery mechanisms have come to the fore. This has led to a hybrid practice of design-build contracting – by some practitioners termed "controlled design-build contracting" – in which the client exercises a larger influence on the design than typical for the usual design-build contract. The client makes the initial contact to a design team for a conceptual design, which is then followed by a slightly adapted design-build contract where the client retains some degree of control of the design (Söderberg et al. 2004; Levring & Bonke, 1996).

The development of integrated delivery mechanisms has been supported by a number of subsequent development programs: Project New Ways of Collaboration, The Client Creates Value (in Danish, Bygherren skaber Værdi), and the PLUS network (Partnering, Learning, Development, Collaboration). The diffusion of integrated delivery mechanisms has been championed by the public authorities and certain key actors in the building process like the contractor NCC. Today, partnering has become a fairly widely used delivery mechanism,

[3] Since August 2011, DBO is also possible when it favours energy efficiency in buildings.

while energy-service companies (ESCO) are in its infancy and mechanisms like public-private partnerships and integrated procurement are seldom used (Larsen et al., 2010).

3. The theoretical framework

3.1 Complexity in service-led projects and managerial consequences

Baccarini (1996) considered that construction projects become progressively more complex. As construction is moving away from its production-based focus by developing new service activities (financing projects, operating and maintaining systems…), project complexity is even stronger since interfaces between stakeholders, organisations and project phases are multiplied.

Project complexity is characterised by two dimensions: structural complexity and uncertainty (Williams, 1999). Structural complexity (Baccarini, 1996) refers to the number of subsystems of a product / the number of specialties and their inter-relationships. Interdependencies intensify complexity since a change in one element will have an impact on the subsystem. Uncertainty can also be classified according two dimensions: the uncertainty in goals is linked to the difficulty of the users / clients to specify their requirements. This increases the risks of changes (i.e re-work). The uncertainty in methods is more due to a lack of experience on a similar project which requires modifying and refining the methods during the course of the project.

Hobday (1998, p.693) introduced the notion of complex products and systems (CoPS). "*CoPS projects normally involve a series of phases including pre-production bidding, conceptual and detailed design, fabrication, delivery and installation, post-production innovation, maintenance, servicing and sometimes, de-commissioning.*" Hobday identifies several indicators to characterise product complexity: the degree of technological novelty, extent of embedded software in product, quantity of sub-systems and components, feedback loop from later to earlier stages, uncertainty/change in user requirements…

The project based organisation is apparently ideal to manage the uncertainties ("*unforeseen and unforeseeable features which occur during design, system integration and production*") that characterised CoPS projects (Hobday, 2000, p.891). However it is not adapted to project learning. Delivering CoPS projects requires the combination of project management capabilities (managing uncertainty and changes in user specifications) and systems integration capabilities. Thus coordination mechanisms between the stakeholders of the construction value added-chain are critical factors for the success of service delivery.

3.2 Governance for integrated solutions provision

Relationships between buyer and supplier are usually based on formal contracts. When all contingencies that might affect the relationship are foreseen by the agents, the contract appears adapted. Buyer and supplier are able to write a clear and enforceable contract. The uncertainty is limited and it is easy to implement and monitor tasks. However according to the framework defined by Williamson (1991), uncertainty, frequency of exchange and asset

specificity render most contracts incomplete. Therefore it is only possible to define procedures for resolving unforeseeable outcomes.

The delivery of CoPS modifies the traditional relationship between buyer and supplier. Indeed the coordinator of the project has to manage networks including suppliers, designers, contractors, facility managers, financial institutions and government authorities. In PPP projects, the coordinator is the Special Purpose Vehicle (SPV) which organises the division of tasks (design, construction, operation and finance) among the partners of the SPV (Brady et al., 2005). The management of these complex interfaces is the key issue to deliver integrated solutions to clients and to create value for the end users.

Within these projects a comprehensive and complex performance measurement system containing key performance indicators often becomes the backbone of operational management. These indicators are established according to the expectations of the public authorities. In case of poor performance or buildings unavailability the payments to the private partners can be reduced. To be efficient, measurement procedures have to go along with the quality of the service. However these long term contracts are by nature complex and incomplete since all contingencies cannot be anticipated (Caldwell et al., 2009). Moreover ex-post contract monitoring costs can be very high with CoPS (Lewis and Roehrich, 2009).

In such situation relational governance is considered as a complement to contracts. One of the key elements of relational governance is trust (Roehrich and Lewis, 2010). When trust replaces uncertainty and opportunism, informal obligations may constitute a more stable framework for interaction (Lundvall, 1988). However for large and complex projects informal control mechanisms are difficult to implement.

4. Case studies

4.1 INSEP

INSEP (National Institute of Sport and Physical Education) brings together a large number of top-level athletes specialising in a wide range of sports. The Institute located in the Bois de Vincennes forest west of Paris, is the training centre for the French sports elite. About half of the medals gained by the French athletes at the Olympic Games (16 out of 33 in 2004, 21 out of 40 in 2008 and 19 out of 34 in 2012) were won by athletes trained at INSEP.

4.1.1 The renovation project:

The renovation project of INSEP was decided in 2005 by the Ministry of Sport. Two different public procurement schemes were used:

1. The renovation of the Southern section was carried out under a public management contract. The Ministry of Sport was the client since it was the best actor to support the risks associated with the management of the sport facilities.

2. A public private partnership tender proposal was retained for the renovation, the maintenance and operation of the Northern section. Since the delivery deadline set to enable the preparation of athletes for the 2008 – 2012 Olympiad was crucial and the complexity of the renovation was high, a partnership contract was considered as the most adapted solution.

The partnership contract was awarded in December 2006 to a consortium gathering three large companies. It concerned the renovation, the maintenance and operation of the buildings for the thirty years of the contract and the delivery of services (hotels, catering, cleaning…). The renovation costs reached 102 million Euros and the annual unitary payment is 12 million Euros. The renovation works started in June 2007 and ended in January 2010.

4.1.2 The governance mechanism within the project

The governance mechanism within the consortium and between the consortium and the public user are different. Within the consortium the company in charge of hospitality issues, coordinates the helpdesk but it does not have any power on the other members of the consortium. The public users criticize in several occasions the role of the coordinator since he was not always able to provide direct answers to day-to-day problems. As a coordinator he transferred the questions to the appointed companies. Thus this organisation hindered communication and created a supplementary administrative layer between INSEP and the companies working on the site. However according to the coordinator, it could have been possible to have a company in charge of managing the other members of the consortium. However it would have resulted in supplementary cost at the level of the final bid.

To monitor the consortium output specifications were integrated to the contract. However some monitoring procedures were not adapted. At the beginning, it took more than half a day to monitor the quality of the cleaning. Therefore both parties agreed to modify their approach. The number of key performance indicators (KPI) was reduced from 276 to 153 in order to improve the efficiency of the monitoring procedure and to enforce the contract.

Despite the formal contract signed between the partners, several changes occurred during the renovation and operation of the buildings. The public authority tended to adopt the behaviour of traditional public owners: INSEP asked for new services once the partnership contract was awarded (e.g. a balneotherapy complex was created and the architecture of the R&D lab was modified after the enrolment of a new manager).

Once the renovation was completed, some contractual services appeared to be not adapted to the day-to-day life of the residents. Consequently services were modified but the financial perimeter of the contract was kept unchanged. There was no financial consequences but according to the private consortium, most changes were time consuming.

4.1.3 The service quality

The construction was not done on time because INSEP asked for several changes during the renovation. Moreover asbestos was found in one building. Under traditional public

procurement the works would have stopped and the client would have modified the initial contract with the contractor. This modification of the initial contract is usually very time consuming and the contractor always tries to benefit from the bilateral negociation. In this project, the contractor who was member of the consortium decided to take the risk (while nothing about this risk was mentioned in the initial contract) and to pursue the renovation works. At the end, the delay was one month. Despite a delay of one month, INSEP was very satisfied since the budget was not modified. Moreover, it was aware that such a result would never have been attained under traditional public procurement procedures.

All actors also indicated that the service quality is better than before. For example the mail desk is open from 8 am to 10 pm instead of 7 am to noon and 2 pm to 5 pm. The reception desk also lengthened its opening hours. New services were created for people who come to INSEP for short training period (such as a luggage room).

Despite these positive feedbacks some elements of dissatisfaction remain. The contract is interpreted differently by the stakeholders. Firstly this is due to a change of employees within INSEP. People who took part to the competitive dialogue and to the signature of the contract are not anymore here. Secondly the output specification was not always well specified.

Budgets for maintenance and operation are also limited because the public authority (INSEP) had no experience in this field and had in the past a very limited budget dedicated to these tasks. Finally it also appears that the interface between the contractor and the system operators (two different companies belonging to the same large French contractor) was not very efficient. Due to a lack of experience in similar projects and to the penalties associated with construction delays the contractor strongly focused on the delivery of the buildings. Moreover the system operator did not have any incentive to adopt a whole life cycle cost approach. This was due to a strong lack of data for technical equipment and to the separation between construction and operation within the consortium.

Maintenance is also lacking since the company in charge of maintenance and operation did not realise that it would have to operate the building 24h/24h. Moreover some renovation activities are still ongoing in the Southern section of the INSEP campus. Thus the private company in charge of cleaning the buildings has to work more than expected because most people living and working on the site tend to bring dust and mud inside the buildings.

Changes during the construction phase have also an impact on the performance of the contract. For example the private consortium had incentives to operate buildings and manage systems in order to reduce energy consumptions. But INSEP asked for new services (e.g. balneotherapy and TV in the rooms of the athletes). Thus the reference base has to be redefined before developing any energy performance mechanisms. This example illustrates the structural complexity of the project as defined by Becattini (1996).

4.2 UN City, Copenhagen

The capitol area of Copenhagen is growing rapidly. As heavy industry is disappearing from the harbour of Copenhagen, new space for urban development becomes available. One of

the most prominent areas is the Northern Harbour of Copenhagen (Nordhavnen). One of the first developments to take place here is the establishment of the UN City.

4.2.1 The project

The intention of the UN City is to establish a joint headquarters for some 1,100-1,200 employees from the seven United Nations agencies presently dispersed around the city of Copenhagen. The UN City consists of two campuses at the Northern Harbour of Copenhagen. Campus 1 encompasses the new administration building for UN and is situated on the Marble Pier (Marmormolen) in the port of Copenhagen. The building will be constructed as a star-shaped building with eight points. The new domicile will be constructed in two phases to be concluded in the beginning of 2013 respectively the beginning of 2014 with around 45,000 m^2 gross floor area and 8,000 m^2 basement.

Campus 2 includes a warehouse, which will handle goods for UNICEF for development and emergency projects around the world. The warehouse was built in the Free Port at the outer part of the Northern Harbour of Copenhagen and was ready for moving in at the beginning of 2012. The warehouse holds a capacity of close to 40,000 cubic meters in a fully automated high bay warehouse.

4.2.2 The governance mechanism within the project

The two most prominent governance processes at play in this particular case are policy processes and business processes. The policy processes are predominantly taking place between the regulatory and institutional framework on one hand and businesses on the other hand. These policy processes between the project and its environment is characterised by: 1) privatisation of public policy through the creation of the developing organisation, and 2) provision of a legal framework for developing the site.

First, the development of Nordhavnen is carried out by the developer CPH City Port and Development I/S. The developing organisation was established in 2007 and is owned 55 % by the Municipality of Copenhagen and 45 % by the Danish government. Being the largest land owner and developer in Copenhagen, the developing organisation plays an important role in the development of Copenhagen. Although the developer is publicly owned and has to comply with a range of public regulations (e.g. on public tendering procedures), the company is effectively operating as a private company. The company is required by law to carry out its activities on ordinary commercial bases, for example through the sale of building rights to the majority of the most attractive sites in Copenhagen. As such the developer is operating without the usual direct democratic control of public organisations and with a more narrow economic scope. Although board members of CPH City Port and Development are appointed politically, the developer is operating at arm's length from the political system. As such CPH City Port and Development is the epitome of what Pedersen et al. (1992) has coined the privatisation of public politics.

The second policy process is related to the provision of a legally binding framework for the development of the actual site. This process is highly institutionalised through the provisions

of the Planning Act. Given the significance of the development of the Northern Harbour, the policy process of providing a legal framework for developing the site took a different route than usual. In December 2005, the City of Copenhagen and the Danish government agreed on the principles that should govern the development of the Northern Harbour. This agreement was turned into a parliament act in May 2007. Based on the winning proposal of an international competition, the Municipality of Copenhagen developed a municipal plan supplement for the entire Northern Harbour and two local plans for the Marble Pier and the nearby Århusgade Quarter in order to set the legally binding framework for the first stage development of the inner part of the Northern Harbour (BY & HAVN, 2009).

Turning from the policy processes towards the business processes, the business processes along the property market and the construction market are characterised by a 1) high degree of complexity on the demand side relations, and 2) reproduction of typical governance mechanisms between the actors in the building process. First, as pointed out by Haugbølle et al. (2012) this case study has illustrated the complex and emergent character of the demand side with multiple user organisations (in this case seven UN organisations), extensive role separation (as owner of building rights, developer, construction client, building owner, financier, user, tenant, leaseholder and letting office), overlapping roles between the regulatory system and the business (the double role of the municipality as both authority and part owner of the developing company), and repeatedly changes in the ownership structure over time.

Second, this case study has illuminated the reproduction of typical business relations between the actors in the building process. Despite the complexity on the demand side and the extraordinary security and confidentiality issues of building for United Nations, the procurement procedures have been fairly conventional in its application of a design contract with the design team. The design-build contractor was selected after an open pre-qualification round, where six tenderers where selected to bid in a limited tender based on economically most advantageous tender following the European regulation on public tendering (Public Sector Procurement Directive, Council Directive 2004/18/EC). Part of the tendering requirement included the obligation of the winning contractor to incorporate the design team in what may be labelled a “controlled design-build” contract.

4.2.3 The service quality

As the building project is still underway, observations on the realised service quality is not yet available. The intention is to design the UN City as a sustainable building. It has a strong emphasis on energy consumption in order to comply with three different set of requirements: The Danish Building Regulations on low-energy class 1 buildings with a projected energy consumption below 50 kWh/m^2/year, the American LEED certification scheme with the goal of achieving a minimum score of LEED Gold, and the developer organisation becoming a Green Building Partner as one of the first Danish organisations (European Commission – Joint Research Centre – Institute for Energy and Transport, 2006). In addition to the energy focus, the building will be using recycled rainwater for toilet flush, cooling will take place with sea water, all lighting will be automatically controlled, and photo-voltaic cells will be installed on the roof of the building.

A second core design principle is to support networking and health by the design of a spectacular staircase in the middle of the large atrium connecting the eight arms of the star. Contrary to the focus on elevators in the 1990s among designers, the architects are now placing much more emphasis on the staircase as a central guiding design in atriums. Elevators are secluded from the atrium in order to encourage users to take the stairs rather than the elevators to promote exercise to improve health and to facilitate networking between the building users.

A third core design principle is related to the strict security concerns applied by UN as an international organisation. Thus the building features a range of security measures to avoid terrorist attacks on UN. For confidentiality reasons most of these security features cannot be described in detail. Some are however evident from the design in itself like. For example the building is being constructed at an isolated island. The only access point will be a bridge accessible only on foot, by bike and with small vehicles.

5. Conclusion

Both cases INSEP and UN City illustrate how construction projects become more and more complex and that complete contracts cannot be written. This is due to:

- The number of interdependencies among the stakeholders of the projects (users and companies in charge of construction and facility management);

- The multiplicity of users with different requirements and the overlapping roles between the regulatory and the business systems (UN City);

- The necessity to define ex-ante services and to propose key performance indicators which will be easy measured (INSEP).

- The uncertainties surrounding these projects which are unique. In the INSEP case, the uncertainties require flexibility in order to deal with all contingencies that were not anticipated at the bid stage. Moreover staff turnover from the public side prevent the development of trust which would have been necessary for the operation of the buildings. It also appears that the user tends to have a strict interpretation of the output specification. The relationships are more based on contractual than on relational governance.

One of the aim of the paper was also to explore whether the move towards integrated solution provision provide better value for the clients. The answer is not straightforward.

In the case of INSEP, the service quality is higher than in the past. Conversely the link between the project execution and the service delivery was not a smooth path. It also appears that the level of requirements of the public user has increased (it did not have the same level of expectation when the service was done by internal staff),

Most studies related to construction focus on the design and construction stages while from a user perspective the operational phase is the key issue. Moreover design and construction last usually around two years whereas operation concerns a minimum of twenty years. Thus more research is necessary in this field to understand how public and private stakeholders can learn to deliver integrated solutions combining building and operation.

6. Acknowledgements

We wish to thank PUCA (Plan Urbain Construction Architecture), the French funding agency that sponsored part of the research and the Danish Energy Agency. We would like also to express our deep gratitude to those involved in the case studies who were interviewed and provided valuable information. However, the views expressed are those of the authors alone and should not be attributed to those interviewed or their institutions.

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