3 Project delivery methods in European social housing energy renovations

Explanatory note

Given the fact that there was no previous available information about the renovation processes carried out by European social housing organisations the first research paper presented in this thesis aims to identify the different types of renovation processes in use and to classify them by their project delivery method. With the aim of having a classification that includes all identified renovation processesnext to the well-known project delivery methods, as been reviewed in Chapter 2, Step-By-Step is added as a specific project delivery method for renovation projects. Renovation of housing by Social Housing Organisations (SHOs) often is not an one-off process, but done step-by-step. In practice for performing each of these steps a project delivery method will be chosen, however focusing on the output of all these processes, step-by-step is treated as a project delivery method itself. The literature review and the survey have shown that construction management at risk is not used by SHOs for renovation projects or not seen as a project delivery method.

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Abstract

Purpose: The aim of the present study was to characterize the main project delivery methods that are used for the renovation of social housing, and to analyse the advantages and disadvantages of their application for energy renovations in order to assist social housing organisations making an informed decision on the choice of a project delivery method that suit their organizational context.
Design/methodologies/approach: The study is based on a literature review, five case studies of renovation processes by five social housing organizations in four EU countries, a questionnaire completed by 36 social housing organizations from eight EU countries, and a series of 14 interviews with energy renovation experts from 10 EU countries.
Findings: Four main project delivery methods were identified: Step-by-Step, Design-Bid-Build, Design-Build and Design-Build-Maintain. Design-Build-Maintain has the maximum potential to deliver energy savings because it facilitates collaboration between the various actors and promotes their commitment to achieving project goals.

Research limitations: The presented data is not meant to be representative for a country or the sector as a whole, but aims to indicate the main characteristics of the current energy renovations carried out by European social housing organizations.
Practical implications: Social housing organizations are provided with useful information about the advantages and disadvantages of different project delivery methods for energy renovation projects assisting them to choose for the option that suit their organizational context.
Originality/value: This study fills a knowledge gap about the project delivery methods currently used in social housing energy renovations and their potential for energy renovations.
Keywords: project delivery method, energy savings, renovation, social housing

§ 3.1 Introduction

In recent years, energy efficiency in the built environment has become one of the main objectives of European policies (Uihlein and Eder, 2009). The initial focus of these policies was on new-build construction, but as the amount of new building delivered each year represents only about 1% of the existing stock (Economidou et al., 2011), renovation of the existing building stock is gaining attention (Murphy et al., 2012).

In order to realize large energy savings through housing renovations, social housing organizations (SHOs) have a privileged position because they are the owners of large housing stocks (Pittini and Laino, 2012). European SHOs are involved in large national renovation programmes because a considerable part of their housing stock needs renovating, as the majority of their properties date from the 1960s and 1970s (UNECE, 2006). National renovation programmes have been focused mainly on improving the health and safety aspects of buildings; a good example is the UK Decent Homes Programme (House of Commons, 2010). Yet, as part of the declared energy-saving aims of EU authorities, SHOs are requested in new national energy savings policies to play a key role. Examples of this trend are the 'Plan Grenelle' in France (Plan Bâtiment Grenelle, 2010), the 'Plan of action energy savings in the built environment' in the Netherlands (Ministry of the Interior and Kingdom Relations, 2011) and the future 'Green Deal' in the UK (James, 2012).

There is no common definition of 'social housing' at the European level because it is characterized by a wide diversity of tenures, providers and beneficiaries. However, it is possible to identify a common aim, namely to provide decent and affordable housing (Czischke, 2009). Social housing is mostly rented out, although dwelling sales and even intermediate tenures are also possible. The providers (SHOs) can be public, non-profit, limited-profit organizations or, in some cases, even private for-profit developers. The beneficiaries are mainly groups that are targeted because of their social vulnerability, although in some countries social housing is open to all citizens (Pittini and Laino, 2012).

The typical SHO is a public or semi-public organization that provides affordable rental housing. Because SHOs offer a public service, the majority must comply with public procurement regulations. Within the boundaries of public procurement regulations, energy performance regulations, their financial position and market circumstances, SHOs are making attempts to implement new renovation processes that promise lower costs and better performance, and take less time. The implementation of more effective project delivery methods for the renovation of social housing could be seen as a strategy to achieve the desired energy savings.

Little is known about the project delivery methods used by SHOs for the renovation of social housing, or about their suitability for achieving successful energy renovations. The literature on project delivery methods is based only on new-build processes and does not take into account the specificities of renovation processes. Therefore, the aim of the present research was to analyse the project delivery methods that are used for energy renovations in European social housing, and to establish their advantages and disadvantages.

The research method is described in the following section. This is followed in Section 3.3 by the literature review that was carried out to identify the renovation project delivery methods. The findings are presented in Section 3.4. The four main project delivery methods applied to the renovation of social housing are listed and their characteristics are described. Section 3.5 presents the conclusions and proposes further research questions.

§ 3.2 Research methodology

The underlying research questions were:

- What are the main characteristics of the project delivery methods used in European social housing renovations?
- What are the advantages and disadvantages of the various project delivery methods when applied to energy renovations?

Energy renovation in this research was considered a major renovation, resulting in an extension of the service life of the building and a significant improvement of its energy performance. We considered maintenance of the building – and especially that of the building services – an integral part of the renovation process (particularly in the first years after completion), otherwise the actual energy savings cannot be measured (Haas and Biermayr, 2000; Hong et al., 2006). The initial status of the building defines the departure line. In order to evaluate the achievement of the renovation objectives, it is necessary to evaluate them during operation time. It is also necessary to include the modifications that were made during the maintenance phase in order to achieve the planned objectives. This is especially important to obtain the desired energy savings, which is the main objective of energy renovations.

Thus, energy renovations carried out by SHOs have several important characteristics that differentiate them from new-build processes:

- There is an existing building with existing energy-use related characteristics, such as insulation, glazing and building services.
- Each dwelling in a building has its own characteristics, and in many cases people are living in the dwellings and continue to do so during the renovation works.
- All the phases until the next renovation (i.e. design, construction and maintenance) are taken into account.
- Four main actors are usually involved: the SHO (the owner), the design companies, the construction companies and the maintenance companies.

Energy renovation projects are thus more complex than new-build projects. First, there are existing buildings and existing dwellings. Therefore, standard solutions cannot always be applied; specific solutions often need to be tailored. Second, the process includes the maintenance phase of the first years after completion. Third, because the maintenance phase is taken into account as part of the renovation process, maintenance companies may play a main role together with the SHO, the design companies and the construction companies.

The research consisted of a literature review, five case studies of renovation processes by five SHOs in four EU countries, a questionnaire completed by 36 SHOs from eight EU countries, and a series of 14 interviews with energy renovation experts from 10 EU countries.

The first phase comprised a broad literature review on construction processes, new build and renovations, and energy renovations in housing. A systematic approach was chosen by selecting all articles from the Scopus database (www.scopus.com) containing the keywords 'project delivery method' and 'procurement route'. In total, 74 papers were reviewed. The majority of the articles addressed the situation in the United Kingdom and the United States, but a few also referred to the situation in other countries, for example Finland, Hong Kong, Norway, South Korea, Sweden and Taiwan.

The second phase entailed an analysis[4] of the current energy renovation processes of five SHOs in four European countries, namely Belgium, France, Italy and the United Kingdom. Members of the SHO and the actors involved in their housing renovations (such as architects, consultants, contractors and maintenance professionals) were interviewed during a three-day visit to each of the five SHOs. This qualitative analysis allowed the identification of six problem areas, namely strategy, work organization, design decisions, tendering and contracting, knowledge and influence on tenants' behaviour.

Based on the results obtained in the second phase, an in-depth electronic questionnaire on the renovation processes carried out by SHOs was elaborated and distributed among national contacts of the European Federation of Public Cooperative and Social-Housing (CECODHAS). The countries represented are Belgium, Denmark, England, France, Germany, Italy, Spain and Sweden. The national contacts were asked to distribute the questionnaire to SHOs that are known to have a strong interest in energy renovations. In total, 36 responses were obtained from different types of SHOs. Therefore, the analysis of the data is not representative of the country or the sector as a whole, but only indicates the main characteristics of the current energy renovations carried out by European SHOs.

The research was complemented by telephone interviews with 14 professionals in 10 European countries: Austria, Belgium, Denmark, France, Germany, Greece, Italy, Spain, Sweden and United Kingdom. The interviewees were asked for their opinion on how to improve collaboration amongst the actors involved in social housing energy renovations. All the professionals (3 architects, 2 technical advisors, 2 real estate advisors, 1 juridical advisor, 1 policy advisor, 2 politicians and 3 builders) have a direct relation with the renovation of social housing and are considered to have a good overview of the current situation. They were proposed by the three partner federations of the SHELTER project, that is, the Architects' Council of Europe (ACE), the European Builders Confederation (EBC) and CECODHAS.

4 In the framework of the SHELTER project of the EU Intelligent Energy Europe programme (www.shelterproject-iee.eu).

§ 3.3 Literature review

§ 3.3.1 New-build construction processes

Construction projects, like other complex projects, involve a large number of actors that interact in different phases of the process. The contractual relations, roles and responsibilities of the actors involved in this process are jointly referred to as the 'project delivery method' in the US literature and as 'procurement routes' in the UK literature. There are a multitude of project delivery methods in use. They are categorized by the US Construction Industry Institute (CII) into three main types: Design–Bid–Build (DBB), which is commonly referred to as the 'traditional' delivery method, construction management at risk (CM at-Risk) and Design–Build (DB) (CII, 1997). DBB and DB are the types most commonly used in Europe (RICS, 2007).

Numerous comparative analyses between project delivery methods have been carried out in the last 20 years (e.g. Ndekugri and Turner, 1994; Anumba and Evbuomwan, 1997; Akintoye, 2000; Pietroforte and Miller, 2002; Hale et al., 2009). In general, it is agreed that DB offers shorter lead times, the involvement of the construction companies in the design decisions, higher price certainty, better communication between the actors involved and reduced construction time compared to DBB. Moreover, clients perceive that DB delivers better value for money and causes fewer disputes.

Despite all the advantages presented in the various studies, there is a general perception that DB is not the best choice for all types of construction projects. Therefore, in addition to the comparative studies, the literature offers several methodologies to help in the selection of project delivery methods (Miller and Evje, 1999; Mahdi and Alreshaid, 2005; Chao and Hsiao, 2012). These methodologies are based on the analysis of such key factors as speed, price certainty, flexibility, quality standards, complexity, risk allocation, price competition and responsibility. But it is hard to evaluate their effectiveness, as the weighting of the different variables is highly dependent on the client's will (Chang and Ive, 2002).

The choice of a project delivery method seems to be related to the way the different construction sectors work. DB was first applied in US infrastructure projects as a result of the government's desire to transfer risk to private parties (Retherford, 1998). This trend evolved in recent years with the emergence of the Design–Build–Maintain–Finance–Operate (DBMFO) project delivery method (Witt and Liias, 2011). However, the transfer of risk from owner to contractor is accompanied by the transfer of control in the project decisions. This dichotomy has been extensively covered by such authors as Friedlander and Roberts (1997), Ghavamifar and Touran (2010), and Osipova and Eriksson (2011).

Apart from the risk allocation, the relationships between the actors involved in the construction process also change in DB processes. Bibby et al. (2006) and Chang et al. (2010) analysed the actors' relationships and concluded that DB offers a better framework for establishing a strong collaboration than DBB. Yet to make it happen, there is a need for a proactive attitude towards collaboration among all the actors involved (Moore and Dainty, 2001; Plane and Green, 2012).

Collaboration in the construction industry is a key topic in the sector. Special interest was first shown in the 1990s when the US Construction Industry Institute (CII) published its report 'In search of partnering excellence' (CII, 1991); interest spread to other countries through the proposals for implementation formulated by Latham (1994) and Egan (1998) in the UK. Even though Latham and Egan did not indicate particular project delivery methods, they did clearly state the aim of achieving a better collaborative environment.

In the last decade, new project delivery methods that fit in the DB category have been developed with the aim of defining an improved collaborative framework; for example, project alliancing in Australia (Australian Department of Treasury and Finance, 2006; Hauck, 2004) and integrated project delivery in the USA (American Institute of Architecture, 2007; Kent and Becerik-Gerber, 2010). The spread of these new collaborative project delivery methods indicates the need for an integrative approach in order to obtain the best possible value project. Moreover, these new approaches are especially well suited to utilize performance-based specifications that facilitate the production of more sustainable and more efficient projects (Hamza and Greenwood, 2009; Molenaar et al., 2010).

§ 3.3.2 Renovation processes

The literature referred in this section relates to project delivery methods in new build because of the lack of literature on project delivery methods in renovation. Moreover, there is little literature related to energy renovations processes in housing. This is quite surprising, as EU authorities have targeted energy savings in the housing sector as one of the crucial elements of their CO_2 reduction policy (Council of the European Union, 2012). The literature that does refer to energy renovations is mainly based on evaluating the energy effectiveness of different building products and systems and their payback time (Papadopoulos et al., 2002; Verbeeck and Hens, 2005;

Harvey, 2009), and especially in Europe on the policies to be applied to promote the widespread use of this type of renovation (Mirasgedis et al., 2004; Tommerup and Svendsen, 2006; Amstalden et al., 2007; Zundel and Stieß, 2011). Nevertheless, an increasing interest in project delivery methods for energy renovations is foreseen due to the spread of energy performance contracting (EPC), which is currently mainly applied to the operation and maintenance of commercial buildings, but has potential in other sectors (Marino et al., 2011; Kellett and Pullen, 2012). In fact, EPC is currently being implemented in some pilot projects for the renovation of social housing, as reported by the Energy Europe project FRESH (Milin et al., 2011).

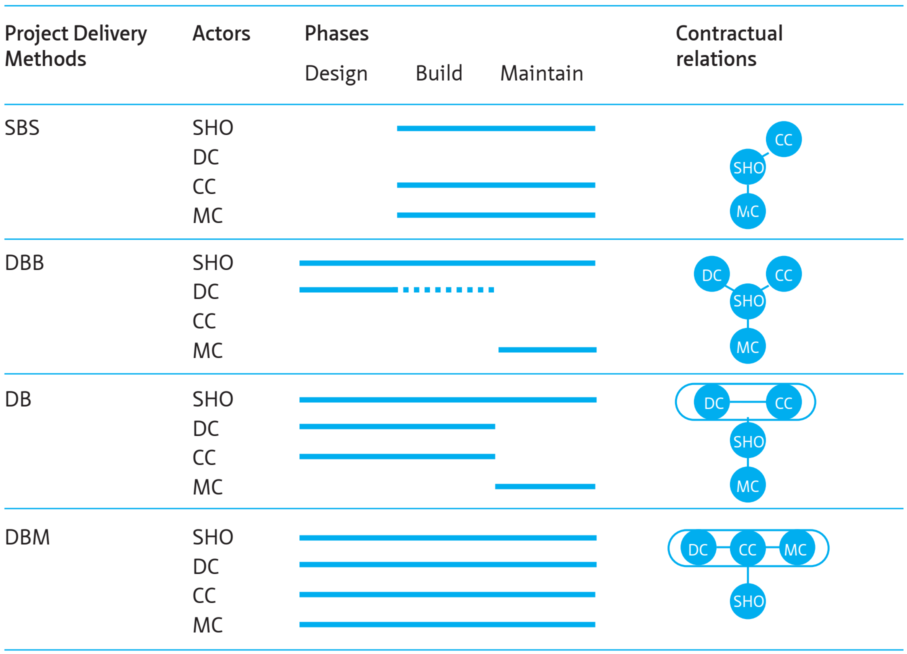
§ 3.4 Findings: energy renovation and project delivery methods

§ 3.4.1 Project delivery methods identified

From the five case studies, four main project delivery methods for the renovation of social housing were identified:

- Step-by-Step (SBS)
- Design-Bid-Build (DBB)
- Design-Build (DB)
- Design-Build-Maintain (DBM)

Figure 3.1 shows the four project delivery methods, the main actors, the building process phases and the contractual relations between the actors. In practice, the SBS project delivery method is a series of Bid–and–Build contracts. However, in the context of energy renovation, SBS is seen as a project delivery method itself. xz



SHO: Social Housing Organisation / DC: Design Companies / CC: Construction Companies / MC: Maintenance Companie
SBS: Step-By-Step / DBB: Design-Bid-Build / DB:Design-Build / DBM: Design-Build-Maintain

FIGURE 3.1 Actors' phase involvement and contractual relations in energy renovations for social housing

Step-by-Step

Step-by-Step renovations can be considered a major renovation when the replacement of a series of building components results in the same condition of those components as after a renovation. In order to optimize the service lives of building components, an SHO might chose to split a major renovation into a series of minor renovations, for example roof insulation, insulation of façades, window replacement, heating system replacement, kitchen renovation, bathroom renovation, electrical installations and decoration. In that case, renovation activities will be carried out by different construction companies and at different times. Cost efficiency is achieved by procuring a large number of replacements only when a particular component has reached the end of its service life. This project delivery method will usually not contain a design phase because the interventions are mainly replacements of building products and systems. A designer would be required only if the appearance of a building is to be altered, structural alterations are to take place or complex building services are involved.

Step-by-Step renovations differ from planned maintenance in that the final status of the dwelling performs better than the initial one. Figure 3.2, which is based on the definition of planned maintenance given by Jones (2002) and that of renovation given by Pereira Roders (2007: 246), shows the difference between planned maintenance, SBS and major renovations.

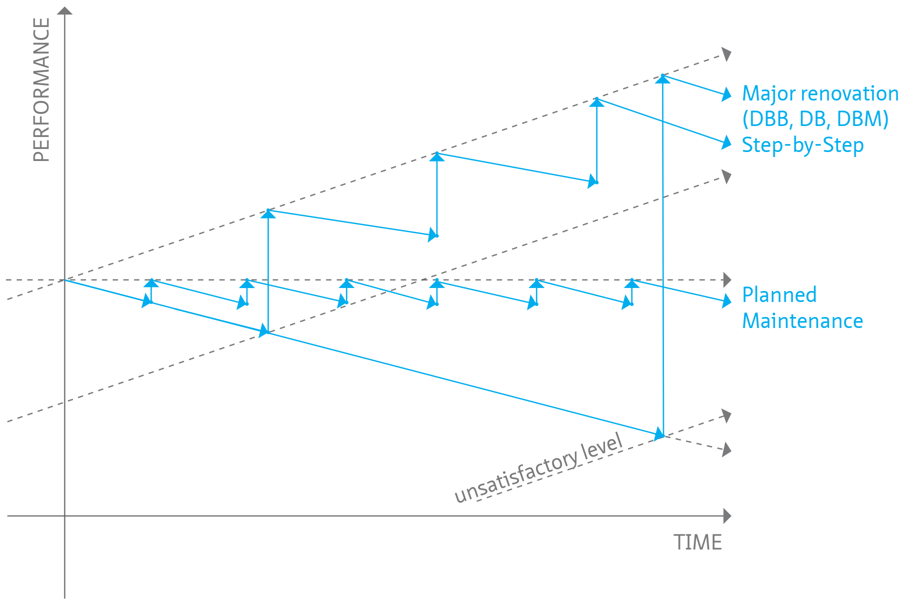


FIGURE 3.2 Step-by-Step renovation versus planned maintenance and major renovation

Design-Bid-Build

In DBB, the various contracted parties (design companies, construction companies and maintenance companies) are involved in the project one after the other. First, the SHO tenders the design work. The appointed design companies develop the technical specifications that will be used to tender construction works, and the successful contractor will deliver the specified works, albeit under the supervision of the designer. Once the works are finished, the responsibility for maintaining the building is transferred to the SHO's maintenance team, which arranges maintenance works, usually by contracting various specialist maintenance companies. To maintain building services, maintenance companies often have a contract with the SHO for a fixed duration (Millross, 2010). Tendering procedures for maintenance are unlikely to have any impact on or connection with tenders for renovation projects.

Design-Build

In DB, the SHO tenders the design and construction works in a single contract. The contracted entity could be a single company, with or without subcontractors, or a consortium that includes design and construction companies. Once the works are finished, the responsibility for maintaining the building is transferred to the SHO's maintenance team and the process continues as for DBB.

Design-Build-Maintain

In DBM, the SHO tenders the design, construction works and maintenance works in a single contract. Again, the contracted entity could be a single company, with or without subcontractors, or a consortium that includes design, construction and maintenance companies. In any case, the people in charge of the design, construction and maintenance are involved in the project from the design phase onwards.

§ 3.4.2 Results of the questionnaire

The results of the questionnaire confirm the common use of these four project delivery methods.

- SBS is the most commonly used project delivery method for social housing energy renovations: it is used by 32 of the 36 SHOs and is applied in 55% of their renovation projects (see Table 3.1).
- DBB is the second most commonly used method: it is used by 34 of the SHOs and applied in 41.5% of their renovation projects. In new build, DBB is considered the traditional project delivery method, but in this survey it did not appear as the most used project delivery method, even though it is still used by the vast majority (96%) of the SHOs in some of their projects.
- DB in renovations is implemented by some of the SHOs, but it is not a common practice: only four SHOs (from the UK and Denmark) use it in some renovation projects.
- DBM is also not a common practice. However, it is used in four of the surveyed countries, namely Belgium, France, Denmark and Italy.

SBS is the preferred option, used for more than 80% of the renovation projects, for SHOs that have a low proportion of tall buildings in their building stock (less than 10% of apartment blocks of more than 5 storeys).

	SBS	DBB	DB	DBM
Number of SHOs using	32	34	5	4
Percentage of projects using	55%	41.5%	1.5%	2%

TABLE 3.1 Number of SHOs implementing each project delivery method and total percentage of projects by project delivery method (n=36)

Of the SHOs, 85% use more than one project delivery method. Implementing SBS and DBB at the same time in different projects is the most common combination: it is used by 67% of the SHOs.

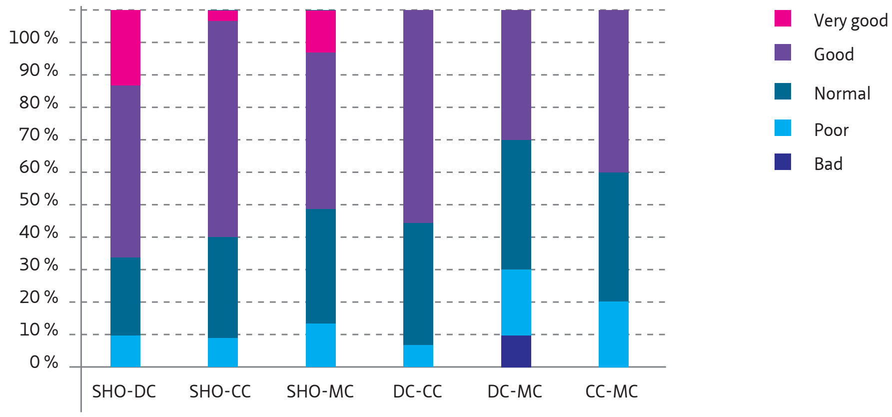
Most (63%) renovation projects are awarded using the most economically advantageous tender (MEAT) principles; the remainder (37%) are awarded according to the lowest price criterion. The majority (47%) of SHOs use MEAT to tender all their renovation projects, 38% make use of both awarding procedures and 15% award only to the lowest price.

A surprising result is that two of the analysed countries use only one awarding procedure: Belgian SHOs use only the lowest price criterion, while Spanish SHOs use only the MEAT criterion. In those cases where MEAT is used the award criteria relate to the experience of the contractor (82%), financial criteria (76%) and the availability of accredited specialists (65%). Other criteria – such as health and safety aspects, environmental impact or energy use – are also taken into account by some SHOs.

Descriptive specifications were made for 69% of the renovation projects. For the other projects, the SHOs made use of performance-based specifications. In three of the countries (Belgium, Italy and Spain), descriptive specifications are used in the vast majority of renovations projects.

In the opinion of the SHOs, the quality of their collaboration with other actors and of the collaboration among the different actors involved in the renovations is good or very good in most of the projects. However, maintenance companies seem to have less good collaborations, especially with design companies and construction companies (see Figure 3.3).

Because of the small sample and the fact that the vast majority of SHOs simultaneously use more than one project delivery method, it was not possible to relate the project delivery methods to the use of specifications and awarding criteria, or to the quality of the collaboration among the actors.



DC: Design companies / CC: Construction companies / MC: Maintenance companies

FIGURE 3.3 Quality of the collaboration among actors

§ 3.4.3 Advantages and disadvantages of the project delivery methods when applied to energy renovations

The advantages and disadvantages of the project delivery methods were identified through a literature review, case studies and expert interviews. Table 3.2 summarizes the advantages and disadvantages and relates the findings to the information sources.

			LITERATURE REVIEW	CASE STUDIES	INTERVIEWS
SBS	+	Split renovation into small interventions	Jones, 2002	UK, BE	
		Components' whole-life costing approach	Straub, 2009	UK, BE	
		Easier to secure specific subsidies		UK, BE	
		Facilitates intervention over pepper-potted stock		UK	
	–	Prevents interactions between components and leads to sub-optimal renovations	Nieboert et al., 2012; Tofield and Ingham, 2012	UK, BE	
		Favours components with a short pay-back time		UK	
		No cooperation between construction teams		UK, BE	

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			LITERATURE REVIEW	CASE STUDIES	INTERVIEWS
DBB	+	Benefit from potential interactions		UK, BE	
		All actors know their role well	Pietroforte and Miller, 2002; Hale et al., 2009	All	
		Well suited to tendering for the lowest price	Constantino et al., 2012	IT	Federation SHOs, BE Construction company, BE
	–	Lack of collaboration between actors	Pietroforte and Miller, 2002; Hale et al., 2009	All	
		Harder to manage liability	Pietroforte and Miller, 2002; Hale et al., 2009	All	
DB	+	Improves certainty of price for renovation works	Pietroforte and Miller, 2002; Hale et al., 2009		Consultancy company, DK Federation SHOs, SE
		Completed in shorter time than DBB	Pietroforte and Miller, 2002; Hale et al., 2009		Consultancy company, DK Federation SHOs, SE
		Performance-based specifications can be implemented	Hamza and Greenwood, 2009; Molenaar, Sobin and Antillón, 2010		Consultancy company, DK Federation SHOs, SE
	–	Direct involvement of SMEs more complicated	Morand, 2003; Peck and Cabras, 2011		Federation SHOs, AT Construction company, BE Construction company, FR
		Precludes referee role of design companies	American Institute of Archi-tects, 2002		Construction company, FR Federation SHO, BE
		Presupposes a change in the role of the actors	Chang, Shen and Ibbs, 2010		Consultancy company, DK Federation SHOs, SE
DBM	+	Improves substantially the certainty of price	Witt and Liias, 2011	2 FR	Consultancy company, DK Federation SHOs, SE
		Transfer the majority of the risk of design failure	Friedlander and Roberts, 1997; Osipova and Eriksson, 2011	2 FR	Consultancy company, DK Federation SHOs, SE
		Easier to use performance-based specifications	Hamza and Greenwood, 2009; Molenaar, Sobin and Antillón, 2010	2 FR	Consultancy company, DK Federation SHOs, SE
		Improves cooperation between design companies, construction companies and maintenance companies	Osipova and Eriksson, 2011	2 FR	Consultancy company, DK Federation SHOs, SE
	–	Direct involvement of SMEs more complicated	Morand, 2003; Peck and Cabras, 2011	2 FR	Federation SHOs, AT Construction company, BE
		Precludes referee role of design companies	American Institute of Archi-tects, 2002	2 FR	Construction company, FR Federation SHOs, BE
		Presupposes a change in the role of the actors	Chang, Shen and Ibbs, 2010	2 FR	Consultancy company, DK Federation SHOs, SE
		Presupposes change in management strategy		2 FR	

TABLE 3.2 Project delivery method advantages and disadvantages and sources of information

Advantages

SBS is per definition undertaken on an elemental basis; for example, all kitchens are replaced at the same time in order to maximize cost efficiency within a limited budget. When SHOs have limited resources, splitting the major renovation into small interventions allows them to reduce costs by delaying component replacements until the end of the components' service life (Straub, 2009). It can also be easier to secure subsidies for specific building products and systems than for a more complex set of interventions, because some funders might think their money was subsidizing other types of work in which they have no interest. The current building stock of numerous European SHOs is widely distributed over a large area (heterogeneously distributed stock – or in the UK, 'pepper-potted stock'; Tiesdell, 2004), because of social policies that intentionally spread lower income people across neighbourhoods to create more mixed communities and, especially in the UK, because of the sale of dwellings to tenants (Tunstall, 2003; Pittini and Laino, 2012). When individual dwellings are heterogeneously distributed, there is no geographically based economy of scale. SBS facilitates a degree of cost effectiveness where there is no geographical concentration.

Disadvantages

The lack of a design phase prevents interactions between different building components or systems. For example, if the roof and the heating system are changed at the same time, it would be easier to install solar thermal panels. In SBS, it is more likely that building products and systems with a relatively short pay-back time will be chosen, missing the opportunity to make bigger life-time savings. It is expected that over the long term, 'sub-optimal renovations' make it harder to achieve high energy-reduction targets and that a combination of energy investments with other investments reduces capital loss and saves money (Nieboer et al., 2012; Tofield and Ingham, 2012).
If design companies are not involved, it is more difficult to identify the potential to add value to the property by building extensions or making beneficial structural modifications, such as widening doorways to facilitate wheelchair access. As well as the lack of a design element, the fact that the different interventions are done by different teams and at different times, prevents cooperation between teams that might also have been able to add value through innovation.

Design–Bid–Build

Advantages

In comparison with SBS, DBB offers the possibility to benefit from the potential interactions between different building components and systems, and is more likely to identify the potential for structural modifications that can add value to the property. It enables a comprehensive solution that can take into account the specific attributes of the property.

In comparison with DBM, DBB is the traditional project delivery method for major renovation projects; consequently, all actors know their roles and what to expect from the process, and the majority of contract documents are well established (Pietroforte and Miller, 2002; Hale et al., 2009). DBB is well suited to tender for the lowest price, which is still seen as the most objective contract award criterion in some EU countries, where it is often the mechanism used to prevent the misuse of public funds. Even in countries that promote the most economically advantageous tendering procedure, not all SHOs make this choice, as tendering for the lowest price is still allowed. This is mainly because tendering for the lowest price entails less administrative burden, in terms of time and responsibility for demonstrating that the selection process is transparent and objective (Constantino et al., 2012).

Disadvantages

The main disadvantage of DBB is the lack of collaboration between the design, construction and maintenance companies. For example, the design company may choose a particular heating system, whilst the construction or maintenance company knows that it does not perform as it should. If the design excludes collaboration, maintenance might be required that could otherwise have been avoided. It is also harder for the SHO to manage liability where any one of the three actors could be responsible for the inappropriate functioning of a heating system but cannot identify who is responsible.

Design–Build

Advantages

DB improves the price certainty for the renovation works, and the majority of the risk of design failure is transferred to the contractor, as a single entity is responsible for design and construction. Moreover, the majority of DB projects are completed within a shorter time frame than is the case with DBB projects, as there is a single tendering procedure and it is not necessary to have a definitive design before starting the works (Pietroforte

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and Miller, 2002; Hale et al., 2009). The use of performance-based specifications can be implemented, because the single entity responsible for design and construction can offer its own solutions that fit with the specifications (Pless et al., 2011).

Disadvantages

Works and design can be tendered in DB only as a single contract, making the direct involvement of SMEs more complicated. It also precludes design companies from acting as referees between SHOs and construction companies. DB also presupposes a change in the role of the actors; as a consequence, extra effort and time is needed to adapt to the new situation (Chang, 2010).

Design–Build–Maintain

Advantages

DBM substantially improves the price certainty for the renovation works and also offers certainty about maintenance costs during a fixed period. The majority of the risk of design failure is transferred to the consortium, being the single entity responsible for the complete process of design, construction and maintenance (Witt and Liias, 2011). Social housing providers own and maintain their properties during a long period. After a renovation the dwellings enter a new functional service that will last for at least 20-30 years. This makes DBM very attractive for energy renovations. The use of performance-based specifications can be fully implemented, because the contractor is still contracted to the SHO for the evaluation of the performance parameters that is to be undertaken during the maintenance phase (Milin et al., 2011). Moreover, a better collaboration among design companies, construction companies and maintenance companies is achieved due the share of responsibility on obtaining the project outcomes, as reported in the two French case studies and supported by Osipova and Eriksson, (2011).

Disadvantages

DBM can be tendered only in a single contract, making the direct involvement of SMEs more complicated. It also precludes design companies from acting as referees between SHOs and construction companies. DBM also presupposes a change in the role of the actors; as a consequence, extra effort and time is needed to adapt to the new situation (Chang, 2010), and a change in the management strategy for the SHO. SHOs normally appoint maintenance companies to be in charge of specific building components and/or building services for either a part or all of their dwelling stock. When a DBM contract is awarded for a project, the maintenance of all property within that project will be carried out by the chosen company, which is unlikely to be the company already contracted by the SHO to maintain its other properties. After awarding several projects using this project delivery method – which are independent events that are due to public procurement legislation – the SHO could end up having problems managing a large number of project-related DBM contracts and non-project-related maintenance contracts.

§ 3.5 Conclusions

The present research provides new insights into the currently used project delivery methods for the energy renovation of social housing, namely Step-by-Step (SBS), Design–Bid–Build (DBB), Design–Build (DB) and Design–Build–Maintain (DBM). SBS and DBB are the most commonly used project delivery methods, while DB and DBM are still used in a small number of projects. The vast majority of SHOs simultaneously use more than one project delivery method, mainly the combination SBS and DBB. In new build, DBB is considered the traditional project delivery method; however, the survey revealed that it is the second most commonly used project delivery method after SBS.

The DBM approach has the maximum potential to deliver energy savings, because it facilitates the collaboration between the different actors and promotes their commitment to achieving project goals. Furthermore, DBM offers a higher certainty of price and less risk of design failure compared to the other project delivery methods. However, the project delivery method by itself will not guarantee the achievement of targeted energy savings. Therefore, numerous factors need to be taken into account when considering changing the project delivery method.

The property asset management of the dwelling stock being renovated by SBS, which is focused on building elements and systems, is completely different from the property asset management of the dwelling stock renovated by DBB, DB or DBM, which is focused on complete properties. It is therefore unlikely that SHOs that are already applying SBS will switch to another project delivery method. Switching from DBB to DBM, or to DB, is feasible as they have a similar property asset management.

The change of project delivery method could be motivated by the use of energy performance guarantees offered by energy performance contracting, which is possible in the case of applying DBM. However, this choice is not suitable for all SHOs. For example, if an SHO has an in-house design team and is changing to DBM (or DB), its design team will not be involved in the project as the contractor will have its own design staff; if an SHO has corporate social responsibility towards SMEs and is changing to DBM (or DB), it will be more difficult to keep SMEs directly involved as they will need to organize themselves into consortia; and if an SHO already has maintenance companies contracted to be in charge of all their housing stock, changing to DBM will create a conflict in their maintenance management, as for every property applying DBM there will be another maintenance company in charge of the maintenance.

The findings of this research are based on a literature review, five case studies, 36 questionnaires and 14 interviews. Therefore, a larger study covering all key EU countries is recommended. Additionally, in order to maximize the performance of social housing energy renovation processes, further research on the optimization of the four project delivery methods described needs to be carried out. Moreover, research should identify possible ways to overcome the current obstacles to the implementation of DBM.

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