Offsite
Modern Methods of Construction in Housebuilding
Perspectives and Practices of Leading UK Housebuilders

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Loughborough University
The challenges facing UK construction are well known. A combination of growing demand, coupled with poor quality and a reducing skills base, has created a dilemma that will not be resolved without a “step change” in productivity and quality of build. The use of Offsite techniques offers a potential solution to this dilemma. Buildoffsite has been set up to promote this option.

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The views expressed in this report are those of the authors, based on the results of the research. They do not necessarily reflect the views of Buildoffsite or its members.

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EXECUTIVE SUMMARY

The increasing demand for housing, coupled with wide concerns over the need to improve performance, has created a powerful case for use of offsite technologies. However, to date, the industry has been slow to innovate and adopt offsite technologies, which has inhibited achieving a step improvement in productivity and quality of housing supply. This study forms part of a three-year research project on the applications of innovative building technologies in housing construction. It reports the findings of a survey of the top 100 housebuilding firms regarding the use of Offsite Modern Methods of Construction (Offsite-MMC). The respondent firms together contribute more than 30% to the total housing unit completions in the industry. This brief summary report outlines the key findings and recommendations of the research to date.

Main findings of the study include:

- The current level of usage of Offsite-MMC in housebuilding is low. Generally, the extent of using Offsite-MMC for flats/apartments is slightly higher than for individual houses. Some highly documented Offsite-MMC techniques are actually only applied to a very limited extent. This is in line with recent figures published by buildoffsite, where offsite was found to be around 2.1% of all construction or 3.6% of all new build (Goodier & Gibb, 2005).
- Nearly two thirds (64%) of the housebuilders indicated that the industry needs to increase the take-up of Offsite-MMC applications, 21% were not sure and only 15% believed that no increase was necessary.
- 58% of housebuilders were planning to increase their use of Offsite-MMC (by volume) in the next three years. The remaining firms (42%) indicated that they planned to maintain their current levels.
- Areas of greatest potential for Offsite-MMC applications were kitchen and bathroom pods (44%), external walls (41%), timber frame (37%) and roofs (33%).
- The most important drivers for using Offsite-MMC in the industry were addressing skills shortages (61%), then ensuring time and cost certainty (54%), then achieving high quality (50%) and then minimising on-site duration (43%).
- The most significant barriers against the use of Offsite-MMC in the industry were higher capital cost (68%), difficult to achieve economies of scale (43%), complex interfacing between systems (29%), unable to freeze the design early on (29%) and the nature of the UK planning system (25%).
- Housebuilders were generally satisfied with their own, in-house, traditional construction methods (72%), and fairly satisfied with the performance of the overall industry in traditional building (49%). However, a significant number of these top housebuilders were not satisfied with the performance of Offsite-MMC, both within their own organisations (31%) and in the overall industry (47%). Many respondents were neutral on this issue (41% & 44%). These results may be affected by the relatively low uptake of offsite technologies to date, a lack of knowledge of Offsite-MMC combined with the traditional risk averse culture in housebuilding. Nevertheless, this perception by housebuilders is seen as a major current barrier to significant increase in offsite for this sector.
- Fixed price / lump sum and in-house management dominated the procurement methods (79% together) for the top 100 housebuilders. 71% of the respondents took Offsite-MMC into consideration from the basic house type design stage.
- Strategies that the firms had developed mainly related to process, procurement, learning, benchmarking and training issues.
- Industry-wide strategies that the firms recommended for increasing the take-up of Offsite-MMC mainly sought to address peoples' perceptions, procurement, costing, planning and building regulations, political levers, decision-making process and practical applications.

This report identifies areas for future research exploring the concerns and strategies of stakeholders in the industry other than housebuilders and project case studies. These case studies would focus on the decision-making process and project performance measurement for Offsite-MMC techniques using Key Performance Indicators (KPIs).
BACKGROUND

Several government-backed reports have suggested that Modern Methods of Construction (MMC) could be part of the solution for addressing the under-supply of housing and wide concerns over the need to improve performance (ODPM 2003; Barker 2003; Venables et al. 2004). However, the industry has been slow to innovate and adopt innovative building technologies (Ball 1999; Barlow 1999). In the Housing Market Intelligence conference in 2004, Housing Minister Keith Hill commented, “We see MMC as a key component to stepping up performance ... but our industry has been very, very slow to respond to that” (Roskrow 2004, p.20). The extent to which offsite is being applied is currently unclear (Construction Manager 2004). Meanwhile, many MMC studies have taken an approach in which they tend to promote offsite applications without necessarily considering all the issues. The nature of housebuilding business with speculative land-acquisition (Roy et al. 2003) and the complex context involving the supply chain and related institutions have been overlooked. There seems an apparent lack of understanding on how to apply MMC appropriately (Pan et al 2004). This report aims to explore these issues based on a survey of the top 100 UK housebuilders on the use of offsite part of MMC techniques (referred to as Offsite-MMC in this report). The survey sample contributed 65% to the total housing unit completions by the industry, justifying the focus on these firms in relation to the uptake of Offsite-MMC.

RESEARCH AIMS AND OBJECTIVES

This research aimed to facilitate the industry’s understanding on the concept and use of Offsite-MMC and provide strategies for an appropriate use of offsite production techniques. To achieve the aims, a two-part study was carried out – Part A) revealed the top 100 housebuilders’ perspectives on barriers and opportunities affecting the likely uptake of Offsite-MMC applications in the future, and Part B) investigated the current Offsite-MMC applications of the top 100 housebuilders. The implementation of both parts of the study was guided by several research objectives (Table 1).

<table>
<thead>
<tr>
<th>Research objectives</th>
<th>Part A</th>
<th>Part B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. To identify housebuilders’ attitudes towards Offsite-MMC applications</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>2. To establish the nature and extent of Offsite-MMC applications</td>
<td>Not applicable</td>
<td>Yes</td>
</tr>
<tr>
<td>3. To reveal the potential trends in Offsite-MMC</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>4. To explore drivers for and barriers against the use of Offsite-MMC</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5. To identify strategies for appropriate use of Offsite-MMC</td>
<td>Yes. Overall strategies</td>
<td>Yes. Overall as well as explored from aspects of approaches for houses and flats, procurement and integration of Offsite-MMC</td>
</tr>
</tbody>
</table>

The two parts of the study, in combination, established the nature and extent of current Offsite-MMC applications and provided a framework for housebuilding firms to apply offsite techniques appropriately. However, this report did not detail how the firms could integrate the strategies identified in the study, nor measure their related performance on an on-going basis. Case studies are suggested for future research to track housebuilding organisations’ decision-making process and measure performance of using Offsite-MMC.

1 Data on the top 100 housebuilders ranked by house unit completion are from Fred Wellings’ Private Housebuilding Annual 2003.
METHODOLOGY

This study comprised a combination of face-to-face and telephone interviews and a postal questionnaire survey, which yielded an overall response rate of 36%. The survey sample was the top 100 housebuilders in the UK by volume (Wellings 2003). According to UK Government statistics, the number of housing unit completions in 2001/02 (UK) was 175,000, out of which private housebuilders contributed 153,500 (or 87% of the total). Based on statistics provided by the Private Housebuilding Annual 2003 (Wellings 2003), the top 100 housebuilders contributed 113,882 (65%) to the total amount by the industry (Table 2). Thus, on this basis, the companies agreeing to take part in the research together accounted for more than 30% to the total housing unit completions in 2004/5. All of the interviews were carried out with senior managers with responsibility for company policy level decisions on whether to use Offsite-MMC within their developments.

Table 2  Housing unit completions in 2001/02 (UK)

<table>
<thead>
<tr>
<th></th>
<th>All dwellings</th>
<th>All</th>
<th>The top 100*</th>
<th>Registered Social Landlords</th>
<th>Local authorities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit completion</td>
<td>175,600</td>
<td>153,500</td>
<td>113,882</td>
<td>21,900</td>
<td>200</td>
</tr>
<tr>
<td>Percentage of all</td>
<td>100%</td>
<td>87%</td>
<td>65%</td>
<td>13%</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Office of the Deputy Prime Minister; National Assembly for Wales; Scottish Executive; Department of the Environment, Northern Ireland. * Statistics of the top 100 are from the Private Housebuilders Annual 2003.

An initial survey instrument was developed through a comprehensive literature review. A set of questions was derived from the work of Venables et al. (2004), the prOSPa project, Lusby-Taylor et al. (2004) and Edge et al. (2002). The instrument was designed in three sections, in a mixture of qualitative and quantitative questions with a methodical use of Likert scales (see Oppenheim 1992). Section 1 targeted overall views of housebuilders on Offsite-MMC applications and figure out the nature and extent of their related applications. Section 2 aimed to identify the drivers and barriers and their importance or significance. Section 3 sought to diagnose the top 100 housebuilders’ practices in dealing with offsite techniques and identify appropriate strategies for the industry to increase the uptake of Offsite-MMC.

The instrument was then refined through discussions with leading researchers and industrial contacts, tested in a pilot interview and sent out to the industry. The survey was implemented in two main steps – 1) questionnaire surveying the top 100 housebuilders, and 2) interviewing, either face-to-face or over the phone, a sample of the top 40. An invitation letter was first sent to the firms in middle 2004 to brief on the survey context and purpose. Some responded and the remaining were progressed by telephone or email. The survey form was emailed to the potential interviewees in advance to make the interview more effective. The main survey was completed early in 2005, with a follow-up conducted late in the same year which clarified the responses to some of the questions. Whilst the sample size precludes the use of sophisticated statistical techniques, it does enable a broad picture of the utilisation of Offsite-MMC methods, and strategies for their future development, to be discerned through descriptive statistics. The data were analysed using a combination of Microsoft Excel and QSR NVivo.
KEY FINDINGS

The nature and extent of Offsite-MMC applications in housebuilding

The current level of usage of Offsite-MMC in housebuilding is low (Figure 1). Generally, the extent of using Offsite-MMC for flats/apartments is slightly higher than for individual houses. Some highly documented Offsite-MMC techniques are actually only applied to a very limited extent in housing. These include complete modular building, bathroom & toilet pods and flat pack, kitchen flat pack, offsite plant room and complete wall panels (both skins). This finding corroborates a recent buildoffsite market value study (Goodier and Gibb 2005) which says that the value of the UK offsite market in 2004 accounts for 2.1% only of the total value of the construction sector, including new build, refurbishment and repair, and civil engineering.

Figure 1   The nature and extent of Offsite-MMC applications

Weighted Rating of the Top 20 Householders’ Practice

- Complete modular building
- MMC stairs/lift
- Kitchen – Flat pack
- Kitchen – Pods
- Bathroom & Toilet – Flat pack
- Bathroom & Toilet – Pods
- Offsite plant room
- Offsite distribution network
- Pre-assembled roof
- Upper floor – Other offices
- Upper floor – Timber cassette
- Upper floor – Concrete and block
- Upper floor – Concrete “mockcore”
- Ground floor
- Internal wall – others
- Internal wall – panels
- Internal wall – Dry-lining
- Internal wall – Blockwork
- Pre-assembled building/panel
- Complete wall panels (both skins)
- External wall – Internal skin panels
- Timber frame
- Pre-assembled timber door/door
- Precast concrete frame
- Structural steel frame
- Pre-assembled drainage & underground services
- Basement ofsite MEC plant
- Basement precast floor
- Basement precast wall
- Other offsite foundation
- Precast pads
- Precast piles

Legend:
0 = Never
1 = Rarely
2 = Sometimes
3 = Mostly
4 = Always
The trend in Offsite-MMC applications

Nearly two thirds (64%) of the housebuilders indicated that the industry needs to increase the take-up of Offsite-MMC applications, 21% were not sure and only 15% believed that no increase was necessary (Figure 2). The larger housebuilders were more favourable to increasing offsite take-up. Hooper and Nicol (2000), based on a nationally representative survey of volume housebuilding firms (defined as those producing in excess of 1000 units per annum), also identified that many companies believed that significant technological change would impact upon the industry in the future which supports this finding.

**Figure 2** Does the industry need to increase take-up of Offsite-MMC?

More than half of the housebuilders (58%) were planning to increase their use of Offsite-MMC (by volume) in the next three years. The remaining firms (42%) indicated that they planned to maintain their current levels (Figure 3). The larger housebuilders were more likely to increase the use of Offsite-MMC. The results show that the majority of housebuilders were open to the increased take-up of offsite technologies. However, comments made along with those results reveal that there is still a risk-averse attitude to the use of innovative techniques among a significant number of housebuilders.

**Figure 3** The trend of using Offsite-MMC in the top 100 housebuilders (by volume)
The aspects of housing with the greatest potential growth for Offsite-MMC applications were considered to be kitchen and bathroom pods (44%), external wall (41%), timber frame (37%) and roofs (33%) (Figure 4). The housebuilders did not generally see great potential for complete modular buildings. The analysis of comments revealed that housebuilders assessed the potential for Offsite-MMC applications against a wide range of factors including technical requirements, cost, time, site integration, customers’ choices, sales, mortgage issues and site specifics.

**Figure 4**   *Elements which offer greatest potential for Offsite-MMC – the top100’s view*

![Diagram showing elements which offer greatest potential for Offsite-MMC](image)

**Drivers for using Offsite-MMC**

The most important industry-wide drivers for housebuilders to use Offsite-MMC were addressing skills shortages (61%), then ensuring time and cost certainty (54%), then achieving high quality (50%) and then minimising on-site duration (43%) (Figure 5). The time and quality drivers were also highlighted in the studies of Goodier and Gibb (2004), Venables, et al. (2004) and Parry et al. (2003). Analysis of housebuilders’ comments made along with their quantitative answers reveals that the conventional drivers of time, cost and quality are still strongly influencing the industry in deciding whether to use innovative building technologies. Factors such as health and safety, sustainability and clients’ influences appear to be largely overlooked.
The top 100 housebuilders’ drivers for using Offsite-MMC in their projects were consistent with those applying to the industry as a whole. However, achieving high quality was indicated as most important and the issues of health and safety and sustainability were taken into account to a greater extent. Various comments, provided by the respondents in explaining their answers, indicated a broad spectrum of housebuilders’ understanding on Offsite-MMC.

**Barriers against the use of Offsite-MMC**

The most significant barriers restricting the use of Offsite-MMC in the industry as a whole were considered to be higher capital cost (68%), the difficulty in achieving economies of scale (43%), complex interfacing between systems (29%), the inability to freeze the design early on (29%) and the nature of the UK planning system (25%) (Figure 6). Goodier and Gibb (2004, p.4) also concluded that “the belief that using ‘offsite’ is more expensive when compared with traditional construction is clearly the main barrier to the increased use of offsite in the UK”. They further argued that the longer lead-in times for offsite were also a significant barrier, particularly to contractors. The risk averse culture, attitudinal barriers, fragmented industry structure, manufacturing capacity were also indicated by a few housebuilders (less than 15%). The concerns of mortgage lenders and insurers with non-traditional buildings were also raised.

Barriers against the top 100 housebuilders’ using Offsite-MMC in their own project were consistent with those applying to the industry as a whole and were mainly related to technical, economic and process issues. Other factors related to procurement, risk averse culture and institutional concerns, however, were not considered relevant.
The housebuilders surveyed were generally satisfied with their own, in-house, traditional construction methods (72%) (Figure 7). They were also fairly satisfied with the performance of the overall industry in traditional building (49%). However, a significant number of these top housebuilders were not satisfied with the performance of Offsite-MMC, both within their own organisations (31%) and in the overall industry (47%). There was also a large number of respondents that had a neutral view on this question (41% & 44%).
These figures illustrate the inertia within major housebuilders against the uptake of Offsite-MMC. Also, housebuilders appeared to be significantly less satisfied with current residential Offsite-MMC performance than other sectors, for example the building services sector claim around 72% satisfaction (BSRIA - Parry et al. 2003). This finding does not necessarily suggest housebuilders do not believe that there are considerable potential benefits from using Offsite-MMC. Instead, the current low level of satisfaction with Offsite-MMC applications may be largely attributable to the low level of application of such technologies (Figure 1) with builders, not surprisingly, being supportive of their well understood work methods. Furthermore, because many of the respondents had actually made very little use of offsite techniques themselves, their answers may be biased by external influences & perspectives. There is also evidence of a critical lack of knowledge on the use and benefits of Offsite-MMC. This may also support the view that construction companies are typically risk averse and do not include many innovators or early-adopters (Moore 2002; Rogers 2003), preferring to allow others to take the risk of developing new products before they adopt them for themselves. Notwithstanding, this perception by housebuilders is seen as a major current barrier to significant increase in offsite for this sector.

**Procurement and integration of Offsite-MMC**

Fixed price / lump sum and in-house management dominated the procurement methods (79% together) that the top 100 housebuilders were currently using (Figure 8). Further detailed analysis concentrated on the offsite elements and found that more than half (57%) of the respondents preferred to use a fixed price / lump sum method for offsite, rather than strategic partnering alliance, project partnering or design and build.
However, results on integration indicate that 71% of the respondents took Offsite-MMC into consideration from the basic house type design stage (Figure 9). The inconsistency between these results suggests that most housebuilders were aware of the principle of integrating Offsite-MMC early on but, in practice, adhered to conventional procurement methods.

**Strategies used for Offsite-MMC applications**

Strategies that the firms had developed to stimulate innovation mainly related to process, procurement, learning, benchmarking and training issues. Factors of market-focusing, peoples’ preconception, planning and building regulations and finance were also identified, but less frequently. The majority of the top 100 housebuilders considered Offsite-MMC differently for individual houses and flats, from the aspects of applicability, finance, speed, business model, people’s preconception, volume and flexibility. It is worth noting that the four main areas of their strategies were almost about the stakeholders who are directly involved in the project delivery process (e.g., housebuilders themselves, designers, manufacturers and suppliers). However, those stakeholders who are indirectly involved (e.g., the public, mortgage lenders, insurers, planning authorities, building controls) were seldom mentioned.
This discovery suggests that housebuilders had developed substantial strategies within their direct supply chain, but neglected the considerable potential in the wider context of housing supply for dealing with Offsite-MMC techniques.

A mixed approach of taking advantage of both Offsite-MMC and on-site production has been taken by some housebuilders. The mixed approach favours incremental, rather than radical, innovations. This is not unusual, given the nature of private housebuilding business and the real and perceived barriers currently co-existing in the industry. Hooper and Nicol (2000) highlight the dominant practice among most large housebuilding companies of continual incremental modifications to existing standard house types, rather than the creation of new designs. They argue that a quarter of the leading companies are making attempts to rationalise their house type portfolios significantly, to a small core of designs.

A number of housebuilders have linked Offsite-MMC with their organisational strategic management to realise all the potential benefits from offsite production. Seaden et al. (2003) studied two sets of variables of business environment and business strategies on innovative practices and suggest that innovation leads to improved competitive advantage and greater profitability. However, innovation is risky, requires significant investments and is often resisted within the firm. This justifies the strategies developed by housebuilders on learning, benchmarking and training.

**Strategies recommended for Increasing the take-up of Offsite-MMC in the Industry**

1) **Peoples’ perceptions should be challenged**

The responses indicated that there are significant perceptions against the take-up of Offsite-MMC among housebuilders and institutions. Smaller housebuilders were even more reluctant. It was felt that Offsite-MMC techniques need to be tested and demonstrated as providing as good or better performance than traditional methods. Providing a UK central site with practical examples of using Offsite-MMC techniques should be very helpful. Institutions were required to develop a consistent and objective approach to the use of offsite techniques.

2) **Improved procurement is the key to achieving long-term success**

Many housebuilders said that partnering had not been fully understood by the industry. Cooperation between housebuilders and manufacturers / suppliers was weak in many cases. Many suggested forming Strategic Partnering Alliances (SPA). Manufacturers and suppliers should be integrated into the decision-making process as early as possible and cooperation between them should be improved.

3) **Better cost data and more competitive costing are required**

Perceived higher capital cost was identified as the most significant barrier against the use of Offsite-MMC. It was recommended that better cost data and more competitive costing should be obtained and an approach ‘vale for money’, rather than ‘cost focus’, should be demonstrated. Many also suggested increasing design standardisation and addressing the issue of economies of scale.

4) **Planning needs to be more flexible and changing building regulations must be acknowledged**

The responses reveal that the slow process of obtaining planning permission and changing building regulations are inhibiting the use of Offsite-MMC. It was suggested that the planning system needs to be more flexible to consider Offsite-MMC techniques. Dialogues between housebuilders and the related authorities must be established. Housebuilders should ensure compliance with enhanced building regulations and designers should not sacrifice design flexibility when specifying the use of offsite techniques.

5) **Political levers will encourage the use of Offsite-MMC**

A significant number of respondents indicated that the government should subsidise the use of Offsite-MMC. Tax deductions should be awarded to permit the cost of the “learning curve” in housebuilding organisations to be recovered. Also, it was suggested that the supply of more traditional building choices should be reasonably restricted to provide a more favourable context for the use of Offsite-MMC.
6) Guidance on the decision-making process and practical applications should help increase the take-up of Offsite-MMC

Many housebuilders indicated that the use of offsite techniques appears more applicable for particular building types and/or house elements. Project circumstances should also be taken into consideration.

Concerns with skills shortages and mortgageability were also indicated but no detailed information was provided. All these strategies required an input from the whole supply chain, covering the housebuilders, designers, manufacturers and suppliers, institutions and the government.

It is important to note that the strategies both in use and recommended were based on housebuilders’ specific experience and knowledge of Offsite-MMC within the context of their companies and projects. They should be treated more like analytical strategies than quantitative formula for the use of Offsite-MMC.

CONCLUSIONS

This report has revealed that the current uptake of Offsite-MMC by the leading UK housebuilders is relatively low. This situation is likely to improve, albeit that growth in Offsite-MMC may be limited in the foreseeable future unless additional ‘external’ measures are taken. Considerable work in this sector is needed to achieve buildoffsite’s targets for growth of 100% by 2010 and ten-fold by 2020. A combination of cost, technical, process and cultural barriers is clearly inhibiting the uptake of Offsite-MMC. Leading housebuilding firms have accordingly developed strategies mainly on aspects of process, procurement, learning and benchmarking and training. However, more inputs from stakeholders who are not directly involved in the project delivery are needed. A continued emphasis on rapid, low cost and high quality housing may lead to an increased uptake of Offsite-MMC in the future, but the effect of this growth is unclear at present.

FUTURE RESEARCH

The study opens up potential new avenues of research with similar surveys of stakeholders in other industry sectors. These surveys should be also designed to investigate the other stakeholders’ perspectives on the Offsite-MMC applications in the industry and diagnose their practices associated with the use of offsite techniques. Project case studies are also suggested for future research. These case studies would focus on the decision-making process in which Offsite-MMC techniques are integrated and the project performance on which the benefits of using Offsite-MMC are measured using Key Performance Indicators (KPIs). This would complement the analytical strategies developed in this report in a more quantitative manner.
REFERENCES


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Jelson Ltd
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Strata Homes
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