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Housebuilding business models and offsite construction take-up

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Abstract

The potential benefits of offsite construction have been widely reported. However, its take-up in UK construction has been lower than hoped. Previous studies have contributed solutions to accelerating take-up of offsite technology, albeit few examining the issue in business contexts. This paper contributes a novel approach to addressing offsite construction take-up in relation to business models. It reviews the challenges facing UK housebuilding business, maps conventional and emergent business models, and identifies factors capturing and creating value, centering on process and activities, risks, and finance. UK housebuilding is often decoupled from contracting, instead focusing on land acquisition, in response to the dominance of land-use planning. The competitive edge potentially available from technological innovation is often rendered less important or prevalent. However, exemplars do exist regarding incorporating offsite into housebuilders' business strategy, as well as adapting or creating business models to optimize such an approach. A conceptual model is presented here to help illustrate the multi-faceted relationship between business models and offsite construction, which is examined drawing on a number of case studies of large UK housebuilders, the findings of which should help position future enquiries.

CE Database subject headings:

Business models; Offsite construction; Prefabrication; Residential housing; United Kingdom; Housebuilding.

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Introduction

Offsite construction is defined as the manufacture and preassembly of building components, elements or modules before installation into their final locations (Goodier and Gibb 2007). There exist many other similar terminologies of the offsite approach, such as offsite production/fabrication/manufacturing (OSP/OSF/OSM), preassembly, prefabrication, system building, non-traditional building, industrialized building (see Pan 2006), or referred to as ‘modern methods of construction’ (MMC) specifically in the UK (ODPM 2003), or ‘Prefabrication, Preassembly, Modularization, and Off-site Fabrication’ (PPMOF) or collectively termed as ‘prework’ in the US (Song et al. 2005). Their differences however, are subtle. In relation to the degree of offsite work undertaken on the product, offsite construction covers technologies at four levels, namely: component and subassembly; non-volumetric preassembly; volumetric preassembly; and modular building (Gibb 1999).

The benefits, both real and potential, of offsite construction have been widely reported (e.g. Goodier and Gibb 2007; Pan et al. 2007). However, the take-up of such an approach in UK construction has been lower than it could be, with its market share being reported to be less than 6% by value (see Taylor 2010). A number of studies have investigated the barriers and attempted to contribute solutions to enabling an accelerated take-up of offsite technology, from the perspectives of individual projects (e.g. Sparksman et al. 1999; Wilson et al. 1999; Gibb and Isack 2003) or of the industry as a whole (e.g. Housing Forum 2002; Parry et al. 2003; Venables et al. 2004; Goodier and Gibb 2007). However, few have examined the take-up of offsite technology in housebuilding business contexts. Also, the impacts of adopting offsite technology on housebuilding businesses appear unclear. Such knowledge gaps are significant, due to the challenges faced by UK

housebuilders in delivering new homes of quality, quantity, affordability and environmental sustainability (Goodier and Pan 2010). The recent economic downturn and the UK Government Comprehensive Spending Review (TSO 2010) have also imposed another significant challenge on housebuilding businesses.

This paper contributes a novel approach to addressing offsite construction in relation to business models. The concept and theory of business models in the business and management field is introduced and then expanded to cover the building and construction sectors. The current and recent challenges facing the housebuilding business in the UK are then examined, and the drivers and opportunities for the take-up of offsite production technologies in addressing these challenges are explored. The paper maps the relationships between the business models in UK housebuilding and the different types of offsite technology, from which a conceptual model is thus developed. The relationships are then evaluated, drawing on business model case studies of a number of UK housebuilding firms.

Methodological approach

A combined methodological approach underpins the arguments made in this paper, reflected two-fold. The first is a critical review of the literature, across the disciplines of business and management, and building and construction, with the proposition of promoting learning from the former to pioneer the business model angle in addressing increased offsite construction take-up in building and construction. This methodological feature explains the focus of examination of offsite, shifted from the conventional project or industry basis towards a business base. The second is the use of practical evidence of four leading housebuilding organizations' practice of incorporating offsite into their business strategy and of adapting or creating business models in order to optimize the

offsite approach. Although such evidence is drawn from secondary sources, it still helps to illustrate the conceptual model developed in the paper and contextualize the arguments into organizational settings.

The conceptual model developed here is not however, and does not attempt to be, prescriptive. Instead, it aims to enable ‘replication logic’, and its use needs to be adapted to the context of a specific ‘unit of analysis’ in practice (Yin 2003). More use and examination of the model in a broader context will, in principle, move the theoretical sampling of the argument towards quantitative validation. Given the current paucity of research into the interdisciplinary area of business models and offsite technology, this paper contends for an alternative approach to offsite construction research, whilst acknowledging (and encouraging) the potential for future debate.

Business models: concept and theory

Knowledge in the business and management field

Business models have long been necessary features of market economies where there is consumer choice, transaction costs, and heterogeneity amongst consumers and producers, and competition (Teece 2010). The concept only became widely prevalent however, with the advent of the Internet in the mid 1990s. Zott et al. (2010), using the EBSCOhost database, searched articles published in academic and practitioner-oriented management journals during the period Jan 1975 to Dec 2009, and revealed over 1200 articles which contained the term ‘business models’ in the title, abstract or keywords and that such interest has virtually “exploded” in the 15-year period between 1995 and 2010. However, the term is often studied without an explicit definition, but has been generally referred to as

a statement, a description, a representation, an architecture, a conceptual tool or model, a structural template, a method, a framework, a pattern, or as a set (c.f. Zott et al. 2010).

Typical concepts reported include:

- According to Amit and Zott (2001:511), the business model depicts “the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities.”
- Magretta (2002:4) described business models as “stories that explain how enterprises work”, and explained that a good business model answers questions: “Who is the customer? What does the customer value? ... How do we make money in this business? What is the underlying economic logic that explains how we can deliver value to customers at an appropriate cost?”
- Morris et al. (2005:727) defined a business model as “concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitiveness advantage in defined markets”, and also summarized six fundamental components of the concept: value proposition, customer, internal processes/competencies, external positioning, economic model, and personal/investor factors.
- Johnson et al. (2008:52), however, argued that business models consist of four “interlocking elements”, i.e. “customer value proposition, profit formula, key resources, and key processes”, which together create and deliver value.
- More recently, Casadesus-Masanell and Ricart (2010:195) simplified the concept of a business model as “a reflection of the firm’s realized strategy.”
- This is however challenged by Teece (2010:179) who argued that a business model is more generic than a business strategy, and described the functions: “a business model articulates the logic, the data, and other evidence that support a value proposition for

the customer, and a viable structure of revenues and costs for the enterprise delivering that value.”

Zott et al. (2010) summarized the emerging themes of management studies of business models in the recent 25 years: the business model is a new unit of analysis in addition to the product, firm, industry, or network levels; it emphasizes a systemic perspective on how to do business; it encompasses organizational activities; and it seeks to explain both value creation and capture. These authors described the literature of business models as young [compared to classic economics or business studies], burgeoning but quite dispersed. Teece (2010) pinpointed that the concept of a business model lacks theoretical grounding in economics or in business studies, and quite simply there is no established place in economic theory for business models. Such features inevitably introduce a source of confusion and obstruction to research in business models, for example, in housebuilding, which is discussed in the following sections.

Knowledge in building and construction disciplines

Despite the burgeoning literature of business models in the business and management field, such a body of knowledge in building and construction seems to be far under-developed. This proposition however is based on an initial search for articles (from Jan 1990 to Nov 2010) that include the terms “business model” and “construction” in their title, abstract or keywords, using the EBSCOhost database and the informaworld database. Table 1 summarizes some of the searched articles and shows the context of study and any description of business models provided.

(Insert Table 1 here)

Surprisingly, none of the searched articles provide an explicit definition of the business model, although some provide an implicit description of business models in their context of study. The concept of business models in the business and management field seems to have been used in building and construction disciplines by default. However, such a borrowing of the concept for use in building and construction research appears to lag behind the theory development in the business and management field. For instance, Seaden et al. (2003) referred to the business model in developing their conceptual model for analysis of innovation and describing the linkages between the business environment, business strategy, innovative practices and business outcomes. However, their reference to the business model was purely based on the theory of competitive advantage, which has since been criticized for its ambiguity and imprecision (see Green et al. 2008). Such a theoretical base on competitiveness is also reflected in Li et al.'s (2009) study of real estate firms in China in which the business model is implied as a form of competitive advantage. Tykka et al. (2010), drawing on their study of timber framed firms in six European countries, identified new business models, i.e. "organizational innovations" of timber framed firms, by establishing offsite production as well as taking responsibility for construction design, and often on-site assembly from traditional actors. However, there was no definition or explicit description provided of the business model.

Housebuilding business models in the UK

The lack of research into business models is of no exception in the context of UK housebuilding. Nevertheless, two recent reviews of UK housebuilding have examined business models and their relationships with housing delivery (Callcutt 2007) and recovery from the economic downturn (Ball 2010). The Callcutt Review (2007) identifies four business models in UK housebuilding:

- The ‘current trader’ business model, which consists of a cycle of land acquisition, development and outright sale, followed by the vast majority of UK housebuilders, where the housebuilder retains no long term interest in the property.
- The investor model, which denotes that developers retain a long term interest in a developed site, which may consist of housing for rent or the retained portion of shared ownership sales. Therefore, the developer trades a proportion of the up-front development profit for the opportunity of long-term revenues and future capital growth. Yields are likely to be relatively smaller than under the current trade model, but more secure.
- The self-build model, which is related to both the individual owner who builds the dwelling or contracts to architects, builders and other suppliers as needed. This sector contributes 15,000 to 18,000 homes per year, roughly 10% of total production in the UK.
- The RSL (Registered Social Landlord) build-for-sale model, which aims to create mixed communities in which the social and market sale homes are indistinguishable. Due to funding requirements, RSLs are more likely to focus on quality and sustainability, and to welcome innovation, although unlikely to be able to match the major housebuilders experience in delivery.

Ball (2010) described five types of UK housebuilders with distinctive business models:

- Classic private housebuilders, the most popular, operate in an integrated model, including activities from project conception and evaluation, land preparation, building construction, and marketing and sales.
- Residential developers, undertake land development and dwelling sales, but neither building nor design. Instead, they let out build or design and build (D&B) contracts.

- Land developers/housebuilders denote separated land development and housebuilding, i.e. land developer buys land, ensures broad planning approval, adds infrastructure and sells sub-divisions, but housebuilder builds and sells.
- Variants include land developer/residential developer and investor developer. The former is sub-divided land bought by a developer that lets out a build or D&B contract. An investor developer buys land, conceives a project, lets out D&B contracts, holds completed development as investment e.g. student housing, some private renting, most social housing.
- Self builders, which typically build as owner-occupier, using land purchased 'raw' or from a land developer, and full- or part-letting out of design and build.

There is no fundamental difference between these two categorizations; both cover virtually all of the housebuilding businesses in the UK and highlight the significance of the classic private housebuilding business and the complementary but important roles of others. Both categorizations of business models are based on the housebuilding process and activities involved, although they also refer to other factors such as risks, business strategies, organizational forms, and firm structures (see quotes in Table 1).

The housebuilding process generically includes all the activities of bringing forward developable land to create finished and maintained dwellings. For one-off producers (e.g. self-builders), the flow nature of development and production will be limited to one site only. However, for repeat builders, housebuilding activities will be part of a continuous process, likely with several or many similar tasks taking place at different sites. Such repeatability of activities determines the housebuilders' land-banking strategy and mass production approach in order to maintain business continuity, mitigate market risks,

facilitate cash flow, and improve process efficiency for minimized costs. Pan (2006) outlined four principal stages of the housebuilding process in typical large private organizations, which are land acquisition, pre-site, on-site and post-site. In order to facilitate a wider understanding, Pan (2006) also mapped these four stages and their sub-stages in alignment with the phases of a typical construction project as provided in the 'Process Protocol' (Kagioglou et al. 1998) (Figure 1).

(Insert Figure 1 here)

Ball (2010:46) described a series of principal activities in the housebuilding process centered on four broad ranges, 'project conception and evaluation', 'land preparation', 'building construction', and 'marketing and sales'. These two systems of description are similar, although Pan (2006) highlighted the 'pre-site' stage within the context of optimizing the use of offsite production technology, while Ball (2010) emphasized the 'project conception and evaluation' stage in guiding the recovery in housing supply. Consequently, business models are identifiable according to the parts of the overall housebuilding process that firms undertake and the roles they play in that.

In addition to the housebuilding process, risk seems to be another important factor of identifying and justifying the business models. Callcutt (2007) identified three distinct areas of risk that housebuilders following the "current trader" business models have to manage: project risk, market risk, and planning risk. Callcutt (2007) also pinpointed a further risk which housebuilders can plan for, but not ultimately control, i.e. economic risk. This can exacerbate project and market risks. This risk profile expands the two types of risk identified by Barker (2003), which particularly influence housebuilding business, i.e. market risk from house price volatility where a 1% shift in house price can increase or reduce profit by up to 8%, and site-specific risk associated with land acquisition, gaining

planning permission and construction. These risks partly explain why the housebuilding industry is reluctant to make long-term fixed commitments. The risks are also generally recognized in the recent review by Ball (2010) which listed key factors affecting risks in housebuilding. Ball (2010) further argued that if housebuilding business models do not take account of risk, they fail or require substantial public subsidy.

Challenges facing the UK housebuilding business

The examination of the challenges facing the UK housebuilding business cannot be isolated from the analysis of the challenges facing the UK housebuilding industry. The industry-level challenges are significant, some being long-standing while some emerging from, or being triggered, by the economic downturn. Goodier and Pan (2010) discussed these challenges in seven areas which include: housing under-supply and mismatch in nature; the economic downturns; land supply and planning; climate changes; slow take-up of sustainability; concerns on zero carbon; and skills shortages. These areas cover a complicated combination of influences internal and external to housebuilding and at both industry and firm levels. However, they fell short to provide clear or specific analysis of business-centric challenges. Ball (2010) summarized the major constraints, from the housebuilders' perspective, on expansion from current low levels of new housing delivery, which include: a lack of viable sites; a high and growing regulatory burden related to land-use planning and wide-ranging regulations (including zero carbon homes); finance problems with both house-buyers' mortgages and development finance; and a loss of capacity in the industry associated with skills of trades, professions and managerial, firm competences and supply chains. There have been a number of Government/industry reviews (Barker 2003; Callcutt 2007; Killian and Pretty 2008; NAO 2008; Ball 2010) which highlight that the planning system restricts land supply and acts as the most

significant barrier to housing supply. Facing all these challenges, housebuilding businesses are less likely to make longer, more strategic commitments to housing production and supply. They will also be more cautious when addressing the risks associated with land development, building processes and housing sales.

In short, the UK housebuilding business is currently facing significant challenges to the delivery of new homes of quality, quantity, environmental sustainability and cost-effectiveness within a risky and complicated market, whilst also endeavoring to survive and recover from the recent economic recession.

Drivers, opportunities and barriers to offsite construction

Despite these challenges, there also exist a number of drivers for change for UK housebuilding businesses. Goodier and Pan (2010) examined these drivers from the socio-cultural, political, technological, environmental, economic and legislative aspects. A key driver is identified to be offsite construction, focused on in this paper below for discussion within the context of housebuilding businesses.

Drivers for offsite construction in housebuilding business

The benefits of offsite construction have been widely studied, and include reductions in time, defects, health and safety risks, environmental impact, and whole-life cost, and a consequent increase in predictability, productivity, whole-life performance and profitability. Eastman and Sacks (2008) showed that offsite production of building components has become significantly more labor productive than related on-site activities and the rate of offsite productivity growth overall (by 2.32% per annual) is greater than comparable on-site sectors (by 1.43%). Tam et al. (2007) reported that wastage generation

can reduce up to 100% after adopting prefabrication in which up to 84.7% can be saved on wastage reduction. Mullens and Arif (2006) reported that Structural Insulated Panels (SIPs) saved about two-thirds of the site framing labor for walls and roofs with cycle time savings of similar magnitude, compared to conventional wood-framing construction. However, most reporting on the benefits of offsite construction reside in the context of projects (e.g. Sparksman et al. 1999; Wilson et al. 1999; Gibb and Isack 2003; Lam et al. 2007) or the industry as a whole (e.g. Housing Forum 2002; Parry et al. 2003; Venables et al. 2004; Goodier and Pan 2010).

Pan et al. (2007), drawing on their survey of UK leading housebuilders, identified that the most important drivers for the use of offsite MMC were considered to be addressing traditional construction skills shortages, ensuring time and cost certainty, achieving high quality and then minimizing onsite duration. Reducing health and safety risks, sustainability issues, government promotion, complying with building regulations, restricted site specifics were also highlighted. Based on the experience with the Design for Manufacture (DfM) Competition (£60k housing), HCA (2010) concluded that MMC has the potential to: reduce the time for on-site construction, due to more factory based production; reduce build costs through reducing time spent on site and by improving efficiency; reduce the amount of material used and wasted, improve health and safety; and enhance the living experience for residents. The Government's sustainability and 'zero carbon' homes agenda undoubtedly provide incentives for the UK housebuilding business to consider adopting innovative technologies, which offers an imperative driver for offsite construction (Callcutt 2007; Ball 2010; Goodier and Pan 2010).

The benefits of and drivers for offsite construction reported in previous studies are centered on the levels of the industry and projects, while they are also related to the business at the firm level, albeit more implicitly. An explanation is the lack of definition and explicit description of housebuilding business and business models, which contributes to a fragmented, often anecdotal, framework (if any) of measuring benefits and identifying drivers for offsite construction in business contexts.

Barriers to offsite construction in housebuilding business

Pan et al. (2007) identified through their survey of UK leading housebuilders that the significant barriers against the use of offsite and MMC in the housebuilding industry were considered to be higher capital cost, difficult to achieve economies of scale, complex interfacing between systems, lack of ability to freeze the design early on and the nature of the UK planning system. The risk-averse culture, attitudinal barriers, fragmented industry structure, manufacturing capacity, and the concerns of mortgage lenders and insurers with non-traditional buildings were also raised. During the DfM Competition, HCA (2010) identified that the barriers to more widespread use of MMC include: lack of knowledge amongst housebuilders about the systems available and how to build houses using them; lack of a mature and tested supply chain, which includes both the main suppliers and the trades people to support the construction process; uncertainty about the overall cost and performance of the systems compared to traditional construction approaches; concerns about the modular systems leading to blandness and uniformity of appearance (housebuilders have their own range of house types that they build and are tried and tested); and uncertainty about the acceptability to warranty providers, insurers and mortgage lenders.

The recent economic downturn and the Government's large spending reductions have been arguably the most significant barriers to the taking up of offsite technologies in housebuilding businesses. Ball (2010) commented that along with cuts elsewhere, there are reductions in research and development budgets, and that less new build means fewer opportunities to experiment and to innovate. Government-funded social housing has traditionally been the main driver for offsite technologies. However, funding for housing and regeneration was recently cut by 70%, from £6.8bn to £2bn by 2014-15 (Building 2010). Such a steep drop of public funding provides a need for the industry or business to play a leading role in taking up offsite construction.

Relations between business models and offsite construction take-up

The discussion so far implies an approach to explaining the take-up of offsite technologies in UK housebuilding by relating it to business models. However, such implication is currently mainly implicit, possibly due to the lack of research in the area. Taking this approach, the relations between these two concepts are examined in the rest of the paper.

Business models' impacts on offsite construction take-up

Previous research into UK housebuilding (e.g. Ball 1996; Barlow et al. 2003; Meikle 2008) leads to two important observations of the sector: that housebuilding is often decoupled from contracting (i.e. physically building homes), but focused on land acquisition and gaining profit from that process; and that land-use planning determines the housebuilding business strategy, whilst the competitive edge from technological innovation is rendered less important or noticeable.

Following the call for improving quality and efficiency of housebuilding highlighted in the Egan Report (1998) and the Barker Review (2003), a number of studies have explored housebuilding business models and their implications on housing supply and the uptake of innovation. Venables *et al.* (2004) claimed that large housebuilders normally take the role of developing and building houses, some being supported by in-house design teams and partnered with their manufacturers and suppliers, whilst some others have no construction capability and sub-let the entire construction process. This situation complicates what is already a very fragmented sector. An inevitable consequence is that there is little sharing of knowledge and good practice, and hence the take-up of offsite technologies has been inhibited within the sector. Barlow *et al.* (2003) suggested that the business focus on eliciting profits from the development of land and the management of finance during this process, rather than the actual construction process itself, appears to be another factor hindering housebuilders' take-up of offsite. This has been in part attributed to the fact that land prices have a major impact on the final out-turn costs, representing up to 50% of total costs in some areas (Egan 1998). Housing developers have been criticized that they have not done enough to drive down build costs, which have risen significantly (ODPM 2005). It has been claimed that there was a tendency for housing developers to 'land bank' by holding back the release of land or not delivering on planning permissions in order to take full advantage of market conditions and maximize profits (Ball 2010). This however prevents the delivery of increased housing numbers quickly when prices rise (Barker 2003).

The diverse and overlapping nature of the business models of UK housebuilders will not change overnight, whilst their significance to housing supply in a longer term may be subject to Government policy for land supply, as well as sustainability and market changes. The requirement of a good knowledge of local housing markets and planning helps explain

why mainstream construction firms tend not to diversify into housebuilding (Barker 2003) and why there are so few overseas firms active in the UK (Ball 2010). Most housebuilders in the UK operate on the ‘current trader’ model or as ‘classic private housebuilders’. Standard house designs are generally adopted, although configurations will vary substantially depending upon the site and geographical area, which has a significant implication on the take-up of innovation and MMC. This nature of the UK housebuilding business and process imposes a unique (high) risk profile.

Within such a context of business models, offsite production has largely been, and is still being, regarded as a technological solution, often associated to images of offsite manufactured components and systems, rather than as an innovative process potentially affecting the businesses strategically. Because of the dominance of land-use planning, the value of offsite construction has been overwhelmed by land acquisition and land banking strategies. The UK Government’s policy focus on ‘zero carbon’ homes and environmental sustainability (BERR 2008), and the increasingly stringent legislations on energy efficient building (NBS 2010), have challenged the conventional business models in UK housebuilding, which seems to offer an opportunity for innovative and offsite construction approaches while housebuilders start to consider alternative approaches to the way in which they deliver housing.

Offsite construction’s impacts on business models

A number of industry and/or Government backed offsite/MMC initiatives/studies have attempted to increase the impact of offsite on housebuilding businesses in the UK. These include the HBF Barker Review Recommendation 33 Review (c.f. Callcutt 2007), the NAO (2005) MMC study, and the DTI-funded prOSPpa project (Promoting Off-Site

Production Application). Despite these approaches, the opportunity for accelerated take-up of offsite seems to be rendered elusive due to the recent economic downturn and Government Comprehensive Spending Review (TSO 2010). Therefore, it seems rational to argue that relying on any external (e.g. political, environmental) forces is not likely on its own to deliver a step-change towards offsite construction in the UK housebuilding sector. A proposition is therefore taken that such a step-change will only be enabled by a proactive take-up of offsite production by the businesses as part of their organizational business strategy, within an overall innovation-friendly context.

A conceptual model for capturing and creating value

The literature reveals that the two concepts of business models and offsite construction are complicated, though connected, and that their relationship is multi-faceted. Such a relationship can be illustrated in a conceptual model, together with a number of factors capturing and creating value in housebuilding, which function as linkages between business models and offsite construction (Figure 2).

(Insert Figure 2 here)

The business models include not only those reported in Ball (2010) and Callcutt (2007), but also “Vertical integration with manufacture and supply”, “Lateral integration with other construction sectors” (such as civil engineering and infrastructure), and “Specialist builders and consultancies” (Figure 2). The factors, that capture and create value of housebuilding businesses, are centered on: housebuilding “Process and activities” (from land acquisition, pre-site, manufacture and supply, on-site, to post-site); “Risk” (including project risks, market risks, planning risks and economic risks); and “Financial” (covering cash flow, capital investment, return on capital employed, and payment method) (Figure 2).

The process and activities determine the organizational form and firm structures. The risks suggest imperative factors including: land-use planning; sustainability legislations and policy (e.g. 'zero carbon' homes, Code for Sustainable Homes, BREEAM); socio-culture; skills; insurance; and mortgage-ability.

The housebuilding business models impose implications on offsite construction take-up, via the factors capturing and creating value (Figure 2). Such implications, however, may differ from each other, depending on the types of offsite technology employed. Offsite construction can be typically classified by different levels of offsite work (Gibb 1999), as well as by materials, e.g. timber, steel, concrete or hybrid etc. It appears that such implications in relation to the higher levels of offsite production, e.g. non-volumetric preassembly, volumetric preassembly and modular building, may be far more significant than for techniques at the more basic level, such as subassembly and components. The technologies at the higher levels are associated with greater degrees of offsite work, and are more likely to challenge significantly conventional housebuilding practice which largely employs site-based construction methods (see Roy et al. 2003). Therefore, it is believed that greater attention is required in terms of integrating these more advanced offsite technologies into the housebuilding business process if their advantages are to be realized.

Case studies of business models and offsite take-up

Recent years have seen a number of innovative procurement / supply chain strategies (whether or not they can be called as business models is another matter) in UK housebuilding which are derived from or triggered by the take-up of offsite construction approaches. The many publicized examples existed within the major private UK

housebuilders which are seriously embracing offsite technology, e.g. Barratt, Westbury (acquired by Persimmon between November 2005 and January 2006), Redrow and Stewart Milne. All these companies have invested considerable effort and finances in the development of offsite technology and the corresponding manufacturing facilities that underpin these techniques. Examining their experience helps interpret and evaluate the conceptual model developed.

1. 'Advance Housing' was a joint venture established in 2002 between Barrett Developments Plc, one of the largest housebuilders in the UK, and Terrapin International Ltd, a market-leading steel frame and modular manufacturer, which is a good example of some strategic partnering alliances that exist between housebuilding organizations and manufacturers. This alliance was established to apply modern production line techniques to the building industry in order to produce high quality factory-finished homes. It provides an alternative to traditional construction methods through the use of lightweight galvanized steel panels and pre-finished pods. However, the Advance Housing factory in Daventry was closed in 2007. Barratt explained that "getting rid of Advance would enable Barratt to concentrate on its core house building business and manage the integration with Wilson Bowden ... A range of suppliers can provide us with different solutions for different situations, rather than just steel frame, and we will also be able to achieve better economies of scale" (Blackman 2007). Barratt also commented that it will work with offsite suppliers of customized steel and timber frame systems, providing the company with "a broader range of building solutions to deliver low to zero carbon homes at affordable prices, comply with the MMC agenda and deliver the Code for Sustainable Homes" (NFB 2007).

2. Redrow announced on 11 September 2007 that they no longer saw the benefit of direct involvement in Framing Solutions Ltd (its joint venture with Corus established in 2002; possibly the then UK's largest light-steel frame manufacturer). Having gained a greater understanding of MMC, the company (Redrow) planned to divest themselves of the joint venture (NFB 2007). Framing Solutions Ltd was then acquired by Fusion Building Systems. Redrow commented that "In line with our stated intention, we are pleased to have completed the disposal of our interest in Framing Solutions and now look forward to working with Fusion as we ourselves focus upon our core development activities." Corus commented that "We are pleased with the development and growth of light steel framing in the construction sector and in accordance with our strategy this is now an ideal time for a key player such as Fusion to develop this particular business further" (<http://www.framing-solutions.co.uk/htm/press/press.htm>).
3. Space4 (www.space4.co.uk) was launched in 2001 by Westbury as a new way of building, producing closed timber panel systems. Space4 has been specifically developed to meet the growing needs of the housing sector and has collaborated successfully with both the public and private sector in mass housing projects of varying sizes throughout England and Wales. In its first five years of operation Space4 supplied nearly 10,000 dwellings. Space4 is being successfully used by a diverse range of companies and organizations in the public and private housing sector. These include major housebuilders, major building contractors and housing associations across the UK.
4. Stewart Milne Timber Systems, established since 1975, is part of the Stewart Milne Group, one of the UK's largest independent housebuilders. There are two factories, in

Aberdeen and Witney, Oxfordshire, with the overall capacity of production being 12,000 units a year. They commented that “Our success has been built from our ability to build long-term relationships with our partners, and become an integral part of their business process. This allows us to maximize our input and provide our partners with a complete service solution. Our clients include the top 20 private house developers, regional developers, registered state landlords and their preferred contractor partners” (Stewart Milne Group 2010).

The cases presented above illustrate that housebuilders adapt their business models and/or create new business models, in order to enable the effective and efficient use of offsite production technologies. Also, the trajectory of the adapted or created business models (e.g. Advance Housing and Framing Solutions) reveals the dynamics in the housebuilders’ strategy and their focus on the core of their business as capturing and creating value in the development, rather than manufacture and supply or construction technological innovation *per se*. These case studies together help verify the complex and multi-faceted relationship that exists between housebuilding business models and offsite technology take-up. The experience of these leading firms further highlights the importance of the factors of business process, risk and finance in linking their business models and offsite technology application.

It is however worth noting that the model is developed within the context of housebuilding businesses in the UK. The identified relations may not be as applicable to the housebuilding businesses in some other countries where the linkages between contracting and housebuilding are much closer and the decoupling of housebuilding from land acquisition in new housing development is generally much clearer (Meikle 2008). This

proposition is verified by the primary business strategy adopted in housebuilding elsewhere, for example, mass customization through innovation in production in Japan (Barlow and Ozaki 2005), volume housebuilding based on cost leadership in Hong Kong (Chiang et al. 2008), and supply-contractor integration for modular housebuilding in the Netherlands (Hofman et al. 2009). Also, Ball (2008), drawing on an international comparison, concluded that UK housebuilding has a much higher degree of concentration than either Australia or the US, and attributed that to land planning dominance and market diversification of large firms in the UK.

Conclusions

Despite the widely reported benefits of offsite construction, take-up in UK housebuilding has been lower than hoped and is being challenged by the economic downturn and the recent Government spending cuts. Previous research has addressed offsite take-up in the construction industry or in specific projects, whilst such technology in business contexts has been largely overlooked. This paper has contributed a novel approach to addressing offsite construction take-up in relation to business models. Similar to the emerging themes of management studies of business models in the last 25 years as summarized by Zott et al. (2010), the business model in offsite construction research is also a new unit of analysis in addition to the product, firm, industry, or network levels. Such an approach emphasizes a systemic perspective on taking up offsite in housebuilding businesses; encompasses organizational activities; and seeks to explain both value creation and capture in the process of housing delivery.

The paper has reviewed the challenges faced by UK housebuilding business, and mapped the conventional and emergent business models. Key factors capturing and creating value

are found centered on process and activities, risks, and finance. UK housebuilding is often decoupled from contracting, instead focusing on land acquisition, in response to the dominance of land-use planning. The competitive edge obtainable from technological innovation is rendered less important or noticeable. Despite the significant challenges, the UK Government's sustainability and 'zero carbon' homes agenda offer incentives to revive the interest in offsite construction. A conceptual model has been developed to illustrate the multi-faceted relationship between business models and offsite construction. The model is also examined drawing on the adaptation and creation of business models by leading UK housebuilders, which have demonstrated the two-way process of incorporating offsite into, and rationalizing, business strategy, as well as selecting appropriate technologies to add value to their business. The model should also help support the adoption of offsite technologies in housing delivery in other countries, whilst acknowledging that the identified factors and relations may need to be adapted.

Given the nature of the borrowing of the concept of business models from business and management, there is a need for developing a specific definition of business models in the context of offsite construction, as well as for a stronger knowledge base of their relations and interrelationships. The key linkage factors identified in this paper, including process and activities, risks, finance, strategy, organizational form, and firm structure; should form the basis of any such definition. Future research should also aim to collate more information: on the take up of offsite technologies, against the factors, by companies in the different business models; as well as on adopting and developing different business models in order to optimize offsite construction. These two types of information will allow the identification of themes and patterns of capturing and creating value in housebuilding, as

well as the development of more robust arguments on the relationship between business models and offsite construction take-up.

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Table 1 Selected description of business models in building and construction

Author/Year	(Implicit) description of business models	Context of study
Seaden et al. 2003	The competitive advantage business model, i.e. “are firms seeking innovative approaches in response to threats or opportunities observed in their business environment?...how various business strategies influence innovation” (p.604)	Canadian construction firms’ strategic decisions & innovation; survey-based study
Brady et al. 2005	“A new business model ... based on the concept of integrated solutions ... bringing together of products and services in order to address a customer’s particular business or operational needs ... firms intending to shift to integrated solutions business models have to transfer many aspects of their business, from their strategies and positions in the value stream, to their capabilities, organizational structures, cultures and mindsets ... involving specifying, designing, constructing, financing, maintaining, supporting and operating a system/facility throughout its life cycle” (p.572)	The UK construction sector, adopting the integrated solutions model in other complex capital goods sectors
Callcutt 2007	“The vast majority of [UK] housebuilders follow a “current trader” business model which consists in essence of a cycle of land acquisition, development and outright sale ... the developer retains no long term interest in the property.” (p.21)	UK Government commissioned report on housebuilding delivery
Li et al. 2008	“the use of virtual prototyping (VP) technology, the lean production process engaged in the IKEA business model (IKEA model) is studied and implemented ... to optimize construction processes and simplify management activities.” (p.991)	The VP-IKEA approach in a construction project in HK; learning from the furniture supply industry
Li et al. 2009	“an unfavorable operating environment for real estate developers ... need to rethink their business model and create a new form of competitive advantage in order to survive ... for business strategies to be formulated to determine how organizations can move from their current competitive positions to ones that are newer and stronger.” (p.567)	Competitiveness factors of real estate firms in China; survey-based study
Ekholm and Molnar 2009	“New business models, such as strategic partnering will stimulate communication and cooperation in product development” (p.439); “After the deregulation of the housing market ... project developers resigned from the role as process integrators ... the most efficient means for project developers’ competitiveness appears to be a flexible organization able to identify market needs. Access to land with development rights is another important success factor ... There are indications that project developers’ role as process integrators in today’s house-building process is increasingly taken over by suppliers of systems products.” (p.440)	ICT for industrialization of housebuilding in Sweden; interview-based study
Tykkä et al. 2010	“the firms have created product innovations by designing new timber-based building elements or volumes; process innovations by designing lean production processes to produce these timber-based housing elements; and, organizational innovations by establishing off-site production as well as taking responsibility for construction design, and often on-site assembly, from traditional actors ... incumbent construction actors were restricted by their traditional behaviors, which opened opportunities for new business models including close interaction of clients to production processes.” (p.204)	Innovation of timber framed firms in Austria, Estonia, Finland, Norway, Scotland and Sweden; case study
Ball 2010	“... firms adopt various business models in relation to development, building and risk. This variety of firm types is not a matter of voluntary choice but has arisen through a long process of competitive evolution, which leaves certain organizational forms best placed to cope with particular aspects of the building process. However, there remains considerable variety in actual firm sizes...” (p.45)	UK housebuilding industry: promoting recovery in housing supply

Figure Captions List

Figure 1 Typical UK housebuilding process and project phases

Figure 2 Linking business models and offsite construction in housebuilding

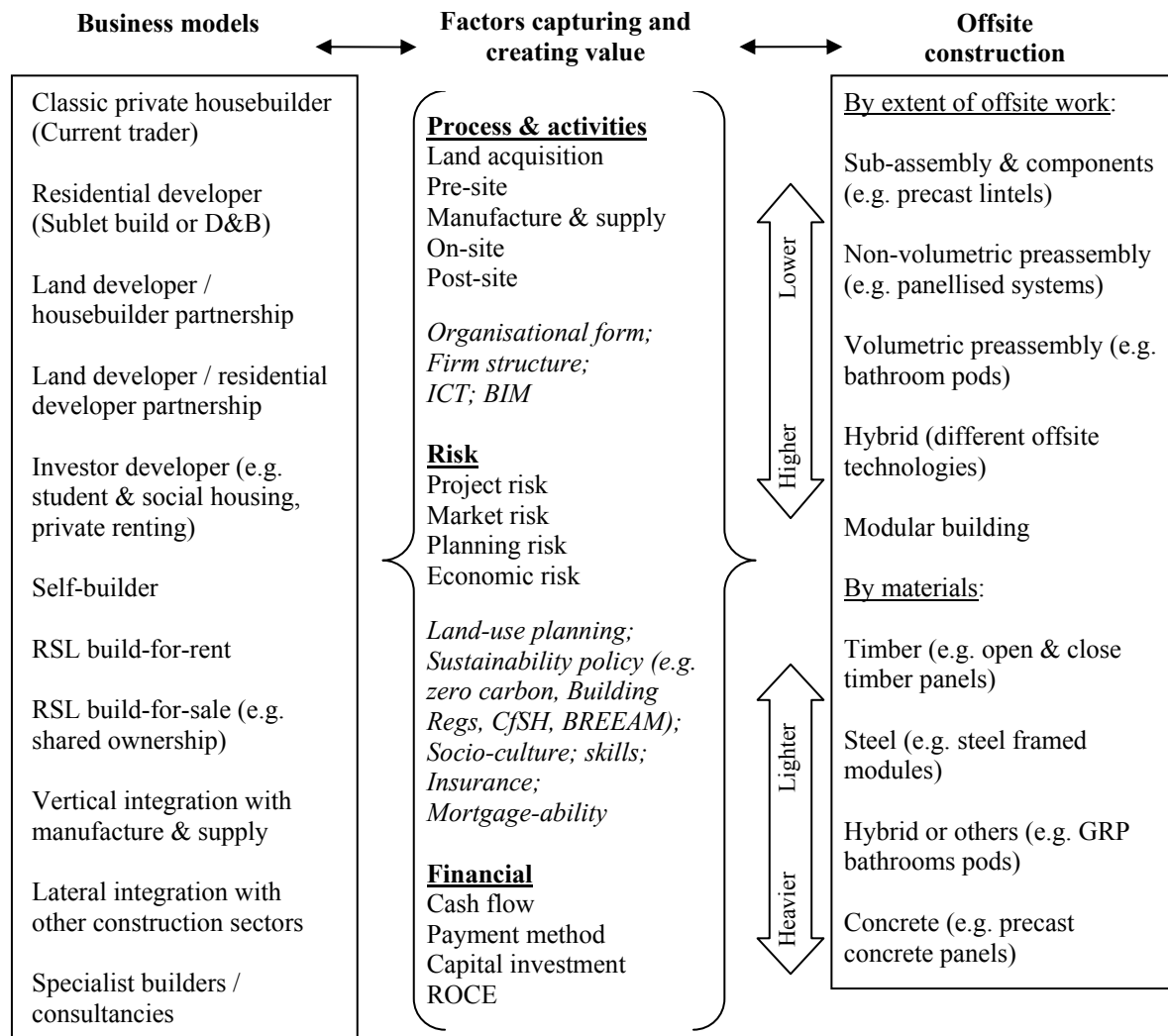
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Figure 1 Typical UK housebuilding process and project phases

Phases in project	Land acquisition						Pre-site		On-site	Post-site	
	Opportunity		Viability appraisal		Proposals			Production information	Manufacture	Construction/assembly	Maintenance and FM
	Demonstrating need	Conception of need	Outline feasibility	Substantive feasibility	Outline concept design	Full concept design	Coordinated design				

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Figure 2 Linking business models and offsite construction in housebuilding



Notes: D&B – Design & Build; RSL – Registered Social Landlord (for delivering social housing in the UK); BIM – Building Information Modeling; CfSH – Code for Sustainable Homes (introduced in the UK in 2006, replacing BREEAM Homes, non-mandatory but specified in most Government-funded schemes; ROCE – Return on Capital Employed; GRP – Glass Reinforced Plastic

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