

FROM CRAFT PRODUCTION TO MASS CUSTOMISATION? CUSTOMER-FOCUSED APPROACHES TO HOUSEBUILDING

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ABSTRACT

There is considerable dissatisfaction with the performance of UK housebuilders in providing products which customers want to buy. Notions of 'customer focus', which have spread through some industrial and retail sectors have largely passed the housebuilding industry by. In its current guise, the industry is unlikely to be able to tackle the demographic and social demands which will be placed on it in the early 21st century. Its challenge is to lower the initial and lifecycle cost of housing, but at the same time improve its quality and functionality.

Notions of 'agile production' hold lessons for housebuilders. Essentially, the industry needs to adopt concepts of 'mass customisation', where highly customised products are delivered at costs comparable with mass production.

The paper outlines the principal features of agile production and its relationship to notions of lean production, before reporting on the extent to which UK housebuilders are shifting their competitive strategies towards increased customer focus and improved supply chain management. The paper then explores some of the organisational, institutional and cultural barriers to the adoption of agile production in British housebuilding. Finally, we introduce a major project which aims to develop and demonstrate lean and agile approaches to private and social housing supply.

KEY WORDS

Housebuilding, lean production, agile production, innovation barriers.

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INTRODUCTION

The British housebuilding industry is criticised for not providing desirable products and for not meeting quality standards expected of modern industry (Barlow and Ball 1999, Ball 1996, Clarke and Wall 1996). Rates of cost reduction and performance improvement are much slower in housing than in many industries, and notions of ‘customer focus’ or ‘relationship marketing’, which have spread through some retail sectors have largely passed housebuilders by.

Not only is this situation unsatisfactory in relation to contemporary housing needs, but in its current guise the housebuilding industry may be unable to tackle the demographic and social demands which will be placed on it in the early 21st century.

The challenge for the industry is to lower the initial and lifecycle cost of housing, but at the same time improve its quality and functionality. In short, it needs to adopt radical approaches to housing supply which are capable of not only meeting initial customer needs, but also providing greater adaptability as needs evolve.

Lessons from other industries suggest that more flexible and cost-effective housing supply systems *could* be developed. This involves making use of a smaller number of standardised interchangeable component sub-systems, and introducing new approaches to supply chain management and customer focus. In particular, notions of ‘agile production’ hold lessons for housebuilders. Essentially, the industry needs to adopt concepts of ‘mass customisation’, where highly customised products are delivered at costs comparable with mass production (Burgess 1994, Kidd 1994, Montgomery and Levine 1996, Nagel and Dove 1992).

After discussing why a new approach to housebuilding is needed, the paper outlines the principal features of agile production and its relationship to notions of lean production. We then report on the extent to which UK housebuilders are shifting their competitive strategies towards increased customer focus and improved supply chain management². In doing this we explore some of the organisational, institutional and cultural barriers to the adoption of agile production. We then introduce a major project, due to start in September, which aims to develop and demonstrate customer-focused approaches to private and social housing supply.

MODERN BRITISH HOUSEBUILDING INDUSTRY

Traditionally, the key competitive strategy for British speculative housebuilding firms has been to optimise their land holdings and time the sale of dwellings to benefit from house price inflation (Ball 1983, Bramley et al. 1995). Land acquisition and marketing skills have been regarded as paramount. Many have argued that this approach has been detrimental to technical innovation in the industry and has resulted in a low wage, unskilled workforce (Ball 1996, Clarke and Wall 1996). However, the inflationary conditions of the 1980s reinforced the dominant land-oriented competitive strategy. Many firms were virtually guaranteed high profits, and the housing product was of secondary importance for meeting financial targets.

² This paper is based on research carried out for a study of barriers to innovation in the British housebuilding industry. It is partly based on 48 in-depth, semi-structured interviews with representatives from housebuilders and their suppliers.

In contrast, for much of the 1990s short-term survival—rather than the development of innovative products or processes—was the main preoccupation the industry. A number of housebuilders grew substantially by acquiring smaller firms. This has helped to minimise risks by diversifying production over more regions and sub-markets. The industry has become increasingly concentrated and specialised. Although there are still a very large number of housebuilders, around 50 per cent of annual completions are built by the top 25 firms, who have steadily increased their share since 1988 (Nicol and Hooper 1999). These are largely specialist housebuilders. New housing, however, remains an essentially mass-produced product, manufactured using craft skills.

The situation in the UK stands in stark contrast to that of some other countries, where the structure of housing supply forces housebuilders to pay more attention to product or process innovation. In Sweden, for example, there has been less scope for developers to make purely inflationary profits because of the system of land ownership and development control (Barlow and King 1992, Barlow and Duncan 1993). In many countries competition for speculative housebuilders is offered by a strong ‘self-promoted’ housing sector, whereby individual households perform the role of developer (Duncan and Rowe 1993, Barlow 1992). In Japan and elsewhere, some housebuilders have transformed the delivery of new housing by adopting component-based approaches used in manufacturing industry (Gann 1996, Gann et al. 1998).

The contemporary British speculative housebuilding industry is, however, facing an environment which may force it to think hard about its competitive strategies. This is partly the result of demographic pressure and partly due to institutional changes.

It is estimated that in England alone up to 5.4 million new dwellings will be required during the period 1991-2016 to account for changing demographic demand (DOE 1996 and subsequent revision). This represents a rate of housebuilding considerably higher than the 1990s. Furthermore, not only is the late twentieth century seeing rapid change both in the demands placed on the dwelling stock by an ageing and fragmenting population, but consumers’ attitudes towards housing may be shifting (Perri 6 1998).

More immediately, it is incontrovertible that the industry is likely to (1) face tighter control over the environmental performance of new housing and (2) there will be greater use of the planning system to influence the location of new development and secure ‘planning gain’ from developers and landowners. Another problem is the impact on profitability of rising construction costs caused by shortages of labour with the craft skills required to produce housing using current building techniques.

Finally, and perhaps more ambiguously, in the medium term the division of labour between workplace and home and broad attitudinal shifts may influence the way the home is used. While the industry’s own surveys (e.g., Dunmore 1997) tend to show a high level of satisfaction with its current products, these must be placed within a context of limited choice in the existing market and owner-occupiers’ concerns over the future saleability of their property (Ball 1998). As yet unknown is how *unrealised* housing needs can be translated into demands for new forms of housing. More immediate pressures on housebuilders may, however, arise from consumers’ experiences of *currently available* new housing. Tight profit margins in the recession of the early 1990s—and intense competition amongst suppliers of building products and components—allowed housebuilders to drive down input prices and reduce the quality of components used in new houses. Some housebuilders have suggested there has been a consumer backlash

against reduced quality standards. There has also been growing concern over the ability of the industry's own consumer protection system to control the quality of its product. Unless the industry is seen to find more effective ways of regulating itself, it is possible that government may intervene with tougher quality standards.

The short term challenge for the industry is therefore to lower its construction costs, and at the same time improve the quality and functionality of its products. The long term challenge is to increase the attractiveness of new housing to consumers. This will involve finding ways of more adequately meeting their initial and evolving needs. Supplying more housing while reducing construction costs will involve substantially improving the technical and organisational efficiency of the housebuilding *process*. It is unlikely that traditional approaches will be able to achieve this, particularly given the skills shortages. Creating new *products* which are more attractive to consumers will require more than simply redesigning existing standard house types.

A number of commentators (e.g., Gann 1996) have argued that these challenges could be met if housebuilders learnt lessons from manufacturing industry. This would involve the construction of housing from a number of interchangeable component sub-assemblies. Such an approach would require a radical reorganisation of the housing supply system, with component manufacturers and end-users playing a much larger role in the design process, and reorganised supply chains. One approach might involve the adoption of agile production.

AGILE PRODUCTION AND HOUSEBUILDING

AGILE PRODUCTION PARADIGM

The concept of agile production was first used at Lehigh University's Iaccoca Institute in 1991 in a report on future strategies for US manufacturing. Since then, it has been promoted as a way of gaining competitive advantage in response to increasingly competitive global markets.

Forsythe (1997) points out that the philosophy does not encompass any new ideas but essentially incorporates a range of different innovations into an effective system. The goal is to quickly respond to customer demand with high quality, low cost products. In contrast to mass production, where goods are produced to stock and sell, agile production produces to order (Goldman and Nagel 1991). This is accomplished by continuous process improvement, waste elimination and rapidly introducing product innovation in response to market changes (Montgomery and Levine 1996). Its high potential for flexibility allows rapid and large changes in production volume, product mix, delivery dates and the range of products (Baker 1996, Kidd 1994).

Agile production is essentially part of a shift in business paradigms towards one which places increased emphasis on the customer. It has been argued that consumers wield increasing power, and expectations - particularly with regard to quality - have increased rapidly in recent years (Hammer and Champy 1993). Furthermore, as consumers are learning to take reliability for granted, the meaning of 'quality' is changing from one which emphasises *reliability* as an objective attribute of a product to one which means *satisfaction*, the subjective response to owning and using a product (Nagel and Dove 1991). Thus 'reliability' in itself no longer brings about competitive advantage.

The key objective for organisations, according to Schonberger (1990: viii), is therefore to:

'serve the customer with ever-better quality, lower cost, quicker response and greater flexibility.'

He points out that these goals were previously thought to be in conflict and argues that by using the right concepts and techniques they can now become mutually supportive.

The ability to provide differentiated final products from largely similar production processes and a relatively standardised core of parts is common in many consumer goods sectors (Chandler 1990, Lampel and Mintzberg 1996). However, Baker (1996) argues that agile production also involves the inclusion of a higher element of service packaged within the product, so increasing the value to the customer. In place of the traditional sale and limited warranty relationship, agile production offers customers a continuously variable mix of products, services and value adding features. To facilitate this relationship, the firm 'communicates with its products while they are in their users' possession' (Goldman and Nagel 1991: 28). Increased customer focus means, amongst other things, the need for a strategic relationship with the customer, a notion that is well-developed in some industrial and retail sectors, where firms have attempted to introduce 'relationship marketing' with their customers (McKenna 1991, Christopher et al. 1991).

To what extent does agile production simply represent an extension of lean production? Kidd (1994) and Montgomery and Levine (1994) argue that lean production is necessary for agile production, but is not a sufficient foundation on its own. While both approaches emphasise small batch sizes, agile production goes further by reducing product development time and allowing for considerable customisation of product characteristics. Baker (1996) develops this idea, arguing that agile production actually opposes some of the fundamental principles of lean production, which allows only limited variation in the volume and mix of products and is thus most effective for relatively standardised products.

Certainly, there are linkages between the two concepts. Both seek to reduce assembly time and produce according to customer demand, whilst avoiding the rigidities of mass production and high costs of craft production. Both require firms to develop a much better understanding of what prospective purchasers require from a product and to focus on their production processes to minimise waste and reduce defects. Arguably, however, lean production is more about improved management of the supply chain in order to raise quality, minimise stocks and ensure continuous improvement, while agile production introduces an added degree of 'customer focus'.

Agile production is therefore built on a foundation of some, but not all, lean production practices. However, as is the case with other management trends - such as business process re-engineering (BPR), or total quality management (TQM) - it is difficult to precisely draw boundaries between what are sometimes related ideas. As Koskela (1992: 6) puts it 'the same concept is used to refer to a phenomenon on several levels of abstraction'. Nevertheless, it is possible to identify a number of requirements for agile production. Essentially, the concept assimilates a wide range of flexible production tools (Kidd 1994, Goldman and Nagel 1991, Forsythe 1997):

- Concurrent engineering, inter-disciplinary design and computer integrated manufacturing (the latter is largely ignored by lean production, according to Baker 1996);
- Just-in-time (JIT) supply of components and materials;
- Improved capture of individual customer requirements and increased customer input into the design process;
- Customer-centred, rather than cost-accounting, performance measures (Suzaki 1987, Schonberger 1990, Montgomery and Levine 1996).

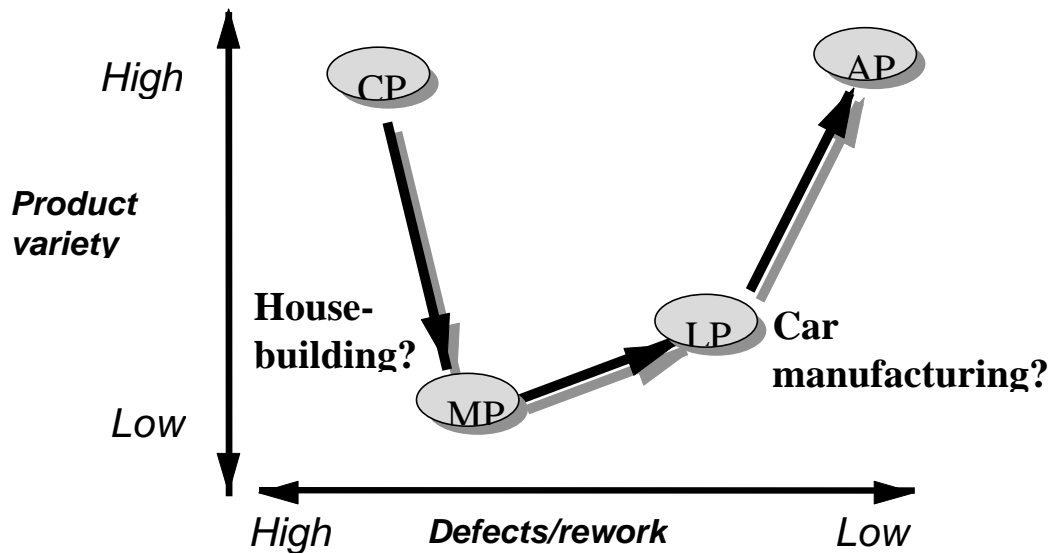
Goldman and Nagel (1991, cf. Kidd 1994, Pant et al. 1994) stress that the success of agile production depends largely on organisational innovation - technology alone is not enough to increase competitiveness. Hence, the system also requires the development of flexible organisational structures and non-hierarchical management styles which support a skilled and empowered workforce. Goldman and Nagel argue that lean production favours large-scale, comprehensive operations, with firms attempting to cover a wide range of functions. In contrast, agile production is founded on collaborative models of organisation, perhaps involving 'virtual firms' which bring together synergistic skills and competencies. Not surprisingly, considerable emphasis is placed by some commentators on the need for high quality information sharing and sophisticated IT systems (e.g., Forsythe 1997).

AGILE HOUSEBUILDING

Figure 1 schematically illustrates the differences between various production systems. Current housing production methods situate the industry somewhere between craft forms of production and mass production. In other words, there is moderate variation in the nature of its products, which tend to display relatively low quality consistency, measured by the amount of rework required on completion. This contrasts strongly with the car industry which has been pioneering lean production concepts for many years and may be moving towards agile production as customer input into the final product, quality and after-care grow.

Identifying user requirements and adding value to increase 'satisfaction' pre-suppose that customers know what they want and their needs can be captured and translated into realisable products. Furthermore, in the case of housebuilding the immediate customer is not always an individual actor. A social housing landlord, as a customer, may well have different requirements from the ultimate user of the dwelling.

The objective of an agile housebuilding system would be to ensure that housebuilders are much better able to respond to customer requirements during the conceptualisation phases of a project and accelerate decisions during its realisation phases. This has traditionally proved especially difficult in the construction industry (Ahmed and Kangari 1995), although some attempts have also been made to develop tools for capturing customer requirements more effectively. Anumba et al. (1996, cf. Dulami et al. 1996) argue that more effective ways of processing clients' requirements and designing quality into the product can be developed using new techniques such as 'quality function deployment' (QFD) and 'design function deployment' (DFD).



CP = craft production
MP = mass production

LP = lean production
AP = agile production

Figure 1: From craft to agile production in the housing and car industries
Source: adapted from Baker (1996)

In organisational terms improving customer focus requires firms to integrate market intelligence with design and product development much more closely, so that customer requirements are channelled directly to managers at key decision points. To achieve this traditional functional divisions based on development, design, production and marketing, may need to be eroded, with decision-making devolved as much as possible.

An additional requirement, which cannot be ignored in the housebuilding industry, is the need for innovation in institutional and regulatory structures. Given the importance of these in shaping the organisational forms and competitive strategies of housebuilding industries (Barlow and King 1992), changes to building codes, planning policies and funding mechanisms are almost certainly a prerequisite for agile housebuilding.

There have been a number of examples of attempts to introduce more flexible and leaner production systems into the housebuilding industries of some countries. The Japanese approach to mass customisation in housebuilding has been extensively documented (see Gann 1996). In most attempts business process modelling has been a precursor to the elimination of non-value added activities and supply chain partnering programmes leading to time compression and reduced total costs (Evans et al. 1997, Melles and Welling 1996, Horman et al 1997, Womack and Jones 1996, Birke 1998). A business process re-engineering methodology has been documented in the US housing industry (Towill 1995).

We have argued that the immediate challenge for the UK housebuilding industry is to lower its construction costs, while improving the quality and functionality of new homes. We have also discussed the principal features of agile production, notably the need for organisational change to support tools designed to achieve increased flexibility in the

production process and capture customer requirements more effectively. British housebuilders are, however, highly conservative. To what extent have the concepts discussed above begun to percolate the industry?

BRITISH HOUSEBUILDERS - LEANER BUT FAR FROM AGILE?

SUPPLY-CHAIN REMODELLING AND LEAN PRODUCTION

We suggested above that agile production is partly reliant on the introduction of lean production techniques, including improved supply chain management.

Supply chain reorganisation, in the form of longer term relationships with smaller numbers of preferred suppliers, has been a primary objective of many private sector housebuilders in recent years. In general, firms have aimed to exert pressure on suppliers to reduce their prices by using bulk buying power. However, while improved information flows may have been a by-product of this process, the distribution process appears to be far from JIT delivery of components and materials. There have, for example, been no attempts - as far as we know - to encourage local distribution merchants to batch together all the components and materials for a specific building site and reduce the number of deliveries. One interviewee felt that it would be hard for them to introduce leaner approaches to procurement:

'Reducing the number of suppliers is OK if you're cranking out standard house types, but forty per cent of our annual output is bespoke designs.'

Another said:

'I like the sentiment, but the logistics are a nightmare and will cutting down on storage increase profits?'

In only a few cases has the introduction of preferred supplier relationships involved the introduction 'partnering', as practised in other sectors of the construction industry. True partnering would include performance incentives and more open and flexible communications at all levels (Barlow et al. 1997). Four examples in housebuilding are:

- Laing Homes, which builds around 2000 homes a year, adopted a 'partnership philosophy' in the late 1980s. This involves one year negotiated agreements for materials and components where there are perceived to be clear advantages in reducing purchasing overheads and improving suppliers' understanding of Laing's requirements. The company has also extended this policy towards subcontractors, especially as labour shortages have grown. To check that the company is still receiving value for money, Laing market tests subcontractors on a regular basis.
- Wimpey Homes, Britain's largest housebuilder with an output of 13,000 homes a year, has also been developing closer relationships with selected suppliers and subcontractors. In 1995 Wimpey introduced a 'charter for change' which partly involved the introduction of lists of preferred subcontractors. Partnering for key inputs was trialled in two regions and the headline benefits are felt to be such that the approach is now being introduced throughout the company. The process has involved selecting the best supplier

in each region and establishing a partnering agreements in return for performance improvements.

- Bovis Homes, building around 2500 homes a year, embarked on a remodelling process in 1990. This included the introduction of national purchasing agreements for some 80 components and materials. These involve fixed prices for two to three years, depending on market conditions, and an element of 'partnership' whereby financial returns are agreed in return for performance improvements.
- David McLean Homes has introduced partnering across the board. The number of sub-contractors has been reduced from 40 to 15 suppliers, each of which is given a contract or written agreement for one to three years. The objective is now to move towards a cost reduction and benefit sharing arrangement. There is now a single supplier for all main materials and components, which is given a one year supply agreement. The aim is to ensure both sides works together to find ways of improving performance and innovating.

The limited adoption of partnering in housebuilding is perhaps a reflection of the highly competitive market for most of its inputs. The relative simplicity and repetitiveness of housing development also means there is no need for close collaboration between client (i.e. developer) and suppliers or sub-contractors to improve buildability, unlike in major building or civil engineering projects. The minimal amount of proprietorial innovation in housebuilding further reduces the need for partnering relationships.

There have been additional constraints to supply chain reorganisations in *social housing* provision. Until recently developers were hindered from adopting longer term supply relationships by Housing Corporation (their principal funder) and Department of the Environment guidelines to foster competition (Smit 1996). However, the government has now signalled that local authorities will be expected to work in partnership with housing associations and local housing companies (*Building Homes* August 1997: 6).

Given the problems of securing an adequate supply of skilled labour in many areas, some housebuilders have tried to develop partnerships with subcontractors, either on a labour only or supply-and-fix basis. This has, in many instances, proved problematic, for two reasons. Firstly, competition between housebuilders in certain areas has made it hard to ensure the loyalty of subcontractors is maintained. Secondly, larger housebuilders have found it hard to find contractors who are large enough to fulfil their requirements over a wide geographical area.

CUSTOMER FOCUS

As we have argued, agile production is built on a foundation of lean production practices and also involves an added degree of customer focus. To what extent have housebuilders begun to address the need for greater customer choice at the initial point of purchase and longer term after care?

There is a perception amongst some housebuilders that in recent years buyers have become more astute and aspirations have grown. This, it has been suggested, makes it increasingly important to identify the specific customers for new housing and communicate with them more effectively. Some interviewees felt that firms producing a product identical to the market norm would be unable to survive in the long term.

However, while the recession of the early 1990s undoubtedly forced firms to respond more closely to *customer demands*, perceptions of *customer focus* remain highly restricted. As Gann et al. (1998) put it:

'there are few major industries in which consumers' requirements are so poorly catered for. New housing is delivered in a way which largely accommodates the constraints of producers, rather than satisfying the needs and aspirations of consumers. ... (M)ost housebuilders have a keen sense of costs but an under-developed understanding of value.' (Gann et al. 1998, forthcoming)

The response to the perceived increase in customer demands is limited to slightly greater choice over fixtures and fittings, faster product redesign, and better systems for dealing with complaints. Mass customisation is not on the agenda. Many housebuilders have, however, begun to introduce changes to their internal organisational structure in order to facilitate a more responsive approach to customers. These seek to erode functional barriers between design, production and marketing and flatten hierarchical management structures, as a way of improving information flows. This process has been reinforced by the introduction of longer term supply chain and subcontractor relationships.

Product Choice and Redesign

Even firms producing housing which is claimed to be as close as possible to individual homes restrict customer design choice to external elevations and minor changes to non-load bearing walls. Many firms still see themselves as builders for a mass market and remain resolutely antagonistic towards greater customer input in production decisions. According to one interviewee:

'we've made up the choice for (purchasers) ... We're a volume builder ... If people want individuality then (we) aren't the right builder for them.'

There are few *technical* barriers to increased customisation of housing. Highly degrees of customisation are a familiar feature of the Japanese new homes market (Gann 1996) and the Dutch and Finnish housing industries have begun to implement the 'Open Building approach, which offers the ability to meet consumer needs whilst providing an adaptive and sustainable environment (Gann et al. 1998). Increased customisation in the UK is largely constrained by current construction lead times, the approach to the development process adopted by housebuilders and institutional factors. The following perceived barriers were highlighted by interviewees:

- The ability to substantially alter dwelling layouts is restricted because the foundations are often completed before purchase decisions are made. Many firms finish their houses as far as the internal walls before asking customers for their input.
- There are concerns over the possible failure of customers to proceed with purchase once customisation decisions have been taken.
- The cost of increased customisation is perceived to be highly unpredictable.

- Local authority planning and design guidelines are felt to impose rigid and often inaccurate perceptions of local architectural vernaculars. This is widely seen as *the* fundamental barrier to greater diversity in housing types.
- Households are generally seen as conservative and preoccupied with the number of bedrooms rather than the absolute amount of housing space. This is felt to hinder the optimisation of internal space through the adoption of more innovative designs.

Most firms have therefore tried to avoid customisation by pre-empting purchaser choice. This is achieved by ensuring they have as wide a portfolio of house types as possible (cf. Nicol and Hooper 1999). One interviewee observed that:

'We like to think we build what the customer wants. We are prepared to offer fairly substantial variations so long as they are not structural and are requested at the right time. Our objective is to build to a high specification to start with and offer people lots of choice in fittings. That way they are less likely to want major changes.'

For this firm, 'major variations' included changing room sizes, and the 'right time' meant before the roof was installed.

The range of standard house types varied considerably between firms, depending on size, regional spread and whether they had recently taken over other firms with their own standard designs. All the case study firms, however, were trying to rationalise their product portfolios and most were increasing the frequency of redesign. Although for housebuilders 'customer focus' does not involve increased *product customisation* - and finding ways of capturing *individual* customer requirements is not therefore an objective - this is not to suggest firms do not engage in market research³. Firms are now far more likely to seek information about customers' experiences of using the home, and to feed this back into the product development process.

Customer After-care

According to most interviewees, 'quality' does not sell houses - most customers assume that new homes will be built to a high standard. Nevertheless, some felt that improving customer care is a major challenge for the industry. Poor service and quality problems were seen as a result of inadequate training and a lack of skilled labour, especially at times of expansion. This has spurred some firms to seek closer relationships with preferred subcontractors, although this is seen as problematic by many housebuilders (see above). Considerable effort is therefore being made to provide better customer after-care. This has taken the form of greatly investment in systems for monitoring complaints improving the response time, and - in some cases - appointment of customer care specialists from outside the housebuilding industry.

Bovis, for example, analyses all complaints on a monthly basis and holds a complaints evaluation and lessons meeting every quarter. The aim is to reduce the snagging list from

³ Although one major national housebuilder has moved away from market research: 'We don't do a lot of market research. At the end of the day the trends are there for you. If we don't sell (homes of a site), that's our market research ... (In the past) we spent a fortune on market research. All we found was people want what they can't afford.'

a current average of 2.2 minor defects to zero defects over the first two years of occupancy. Other housebuilders are focusing on the speed of response to complaints, rather the achievement of zero defects, because they believe customers accept that houses are inherently more complex than other products. The prevailing view was summed up by the Chief Executive of one major national housebuilder:

'You can't 'get it right first time' ... If they can't get it right in a car, with 5,000 checks in a nice warm building, what chance have we got? We're producing our product in 150 different factories around the country.'

After-care does not extend to providing a maintenance and repairs service, which is seen as providing little or no added value. There are also concerns about the inadequacy of local maintenance suppliers who might damage the housebuilder's reputation. Wimpey has tried to overcome this problem by entering a relationship with the Automobile Association's domestic maintenance service to provide a complaints monitoring and response system.

BARRIERS TO BUSINESS PROCESS INNOVATION IN UK HOUSEBUILDING

We argued above that to introduce agile production, housebuilders will need to improve their control of the supply chain and integrate their design, product development and market intelligence functions more effectively. These in turn involve the introduction of new organisational structures and skills. We have also described some of the key business process developments in the UK housebuilding industry. Can these be said to add up to an emergent lean or agile production system?

Table 1 shows the key features of agile production, divided into the fundamental requirements ('level 1 requirements') and their organisational, managerial and technical implications ('level 2 requirements'). The table also identifies the extent to which speculative housebuilders are believed to be taking up these challenges and some of the factors which might stimulate change.

We can draw the following conclusions:

- Although housebuilders are expending considerable efforts in reorganising their supply relationships, lean thinking has barely penetrated the industry. The perception is that the logistics of housebuilding make it hard to organise JIT delivery of components and materials, and the impact on profitability is unclear. Furthermore, the transfer of risk down the production chain to subcontractors appears to reduce the incentive to introduce leaner models for housebuilding.
- While there is some interest in developing closer relationships with customers, in the form of slightly increased customer input at the initial procurement stage and improved after care, this is far removed from the concept of agile production. The introduction of more highly customised housing supply models is largely hindered by concern over costs.
- Progress towards greater collaboration in housebuilding supply chains has been slowed by the level of competition between input suppliers during the

recent recession. True partnering is only now beginning to emerge; the bulk of supply relationships are nothing more than preferred supplier agreements.

Table 1: The take-up of lean and agile thinking in the UK housebuilding industry

<i>Key agile production reqts.</i>	<i>Increased 'customer focus'</i>		<i>Lean production</i>	
<i>'Level 1' reqts.</i>	Increased customisation	'Relationship marketing'	Just-in-time supply	Waste reduction in value chain
<i>'Level 2' reqts.</i>	<ul style="list-style-type: none"> Better capture of customer requirements More responsive production systems Design innovation 	<ul style="list-style-type: none"> Greater integration across production and sales functions Relationships with key sub-contractors & more direct labour Customer-centred performance measures 	<ul style="list-style-type: none"> Better stock ordering and management systems Supply chain partnering 	<ul style="list-style-type: none"> Better stock ordering and management systems Supply chain partnering
<i>Current penetration in industry</i>	<ul style="list-style-type: none"> Improved market information systems More integration of marketing, design, production More multi-skilled teamwork at management level 	<ul style="list-style-type: none"> More emphasis on after-care More teamwork across functions Complaints monitoring & customer performance measures 	<ul style="list-style-type: none"> JIT very limited Partnering is emerging 	<ul style="list-style-type: none"> Reliant on subcontractors to act to reduce waste
<i>Some potential drivers of change</i>	<ul style="list-style-type: none"> Rejection by potential customers of current products 	<ul style="list-style-type: none"> Rejection by potential customers of current products 	<ul style="list-style-type: none"> More development on complex brownfield sites Shortages of skilled labour 	<ul style="list-style-type: none"> More development on complex brownfield sites Subcontractors desire to improve profits

Individually, some of the current innovation trends in the industry - such as integrated management structures or increased use of prefabricated components - provide foundations for agile housebuilding. However, these are being introduced as an ad hoc response to immediate pressures. In the absence of any coherent vision, they cannot be said to represent a move towards product and process based competitive strategies, focusing on the development of leaner and more agile models of housing supply.

CONCLUSIONS

BARRIERS TO CHANGE IN UK HOUSEBUILDING

There are a number of structural features of housing production which inherently diminish its rate of innovation. First, housebuilding is generally organised in sequential stages, bringing together a large number of firms that rely heavily on subcontractors. These attributes mean that the various components the industry operate disjointedly and have different economic characteristics and capacities to innovate. It is potentially difficult to keep any internal innovation proprietary and make early monopoly returns. Furthermore, the amount of feedback from the industry's workforce and markets is lowered, and the industry's organisational learning capacity reduced.

These characteristics are not a uniquely British phenomenon. There are, however, three further barriers to the emergence of a more innovative housebuilding industry in the UK.

Lack of Competition

It has been argued that high levels of competition, resulting from large numbers of firms and low barriers to entry, ensure efficiency in housebuilding (Campbell 1991). But as Lepani et al. (1993) point out, while competition may act as a spur to efficiency, it does not necessarily mean the best available production techniques and products are used. This would only apply if housebuilders had full knowledge of, and access to, all the available technologies and products, if there were a fully informed and discerning body of customers, and the industry were exposed to international competition.

This clearly is not the case in the UK. The undersupply of new housing means that speculative housebuilders face only limited competition - there are few alternative sources of new supply. The social housing sector is targeted at specific population groups and has, in any case, declined substantially during the 1990s. Although the total annual output of the self-procured housing sector is far higher than that of any individual housebuilder, in any given location it is hardly a viable alternative because of problems obtaining suitable land.

Previously Successful Behaviour and Lack of Strategy

The notoriously short-term perspectives of housebuilders are partly the result of the speculative nature of the industry and partly its inability to learn from past mistakes. Most new homes tend to be bought from housebuilders' stocks. Long lead times and limited knowledge about the future state of the market means housebuilders perceive they face an environment of constant 'feast or famine' (cf. Ball 1998). This has resulted in an all-pervading drive to achieve short term financial results. Houses are often completed to suit the requirements of the financial period rather than customers' needs.

More fundamentally, firms have until recently wavered between a preoccupation with short-term survival and a longer term concern with securing enough land to guarantee high profits, should inflationary conditions return. The British housebuilding industry is no exception to Hamel's (1996) observation that strategic planning in most industries tends to be more about incremental change rather than exploring new futures. However,

external threats, a spur to innovation in most industries, have so far merely resulted in the business strategy of growth or complete withdrawal from the market.

Fear of Change

Past attempts at introducing major technical innovations such as systems building or timber frame housing did not generate the expected cost savings. These resulted in wasted opportunities and the adoption of techniques which firms were incapable of using, partly because the necessary inter- and intra-organisational changes were not made and partly because of inadequate training (Gann and Senker 1993). These innovation experiences of housebuilders, and the fact that traditional competitive strategies served them well for most of the 1960s to 1980s, have made them wary of new ideas. Unlike many other industries continuous, incremental innovation has not been especially important for the average firm's survival.

LOOKING FORWARD

While there have been some attempts to introduce more customer choice into housing supply, delivering true 'mass customisation' will require a radical re-organisation of the total production system. One possible model might involve component manufacturers playing a greater role in the design process and users expressing choices directly to housebuilders. These might need to recast themselves as systems integrators, whose role is essentially to act as 'editors' of customers' design and component choices, and land assemblers.

Together with the University of Cardiff and nine housing supply companies, we are embarking on a three year project to test a component-based delivery system which is capable of more closely meeting user needs in a cost effective and sustainable manner.

Traditional site-based activities can produce an almost infinite range of housing types. These involve producing over 70 per cent of value-added on site, normally resulting in high costs, wasted resources, variable quality, and large numbers of defects. Alternative, modular housing systems can be made in factories requiring minimal site-based work: as little as 15 per cent of value-added is carried out in site preparation and connection of services. These methods, however, give limited choice for end-users, although they offer high quality control, fast erection times and certainty over costs.

A component-based approach offers a flexible method in which standardised parts are configured in different arrangements and assembled on site. Typically between 50-60 per cent of value-added is produced off-site. This significantly reduces costs and defects, saves time and increases quality, resulting in customised housing. Japanese examples show how the mix of value-added in factories and on-sites can be varied in order to meet individual customer requirements whilst containing costs and ensuring quality. Scandinavian companies and some self-build systems in the UK use similar methods.

Our work will involve supporting the development, production and evaluation of two sets of demonstration projects. The first aims to demonstrate immediate costs, benefits and barriers to component-based approaches, introducing one or two component systems into each new house. The second aims for a much larger-scale demonstration, involving a wider range of component parts in a number of different house types. In both cases, costs, opportunities, benefits and inhibitors will be compared in public and private schemes.

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