HOUSE BUILDING SUPPLY CHAIN STRATEGIES:

Selecting The Right Strategy To Meet Customer Requirements

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ABSTRACT

Supply chain management has received a great deal of interest during the past few years. There is a concurrent view that a 'save all' strategy applicable to all circumstances is available to industrialists. This paper challenges this view and puts forward alternative house building supply chain strategies for particular market circumstances. Initially a review of the UK house building value stream is presented along with a description of the way in which supply chain management plays a critical role. The general principles behind the two recent popular supply chain approaches, Lean and Agile are presented along with the combination of the two into a single holistic approach called Leagility.

Customer requirements are diverse in the house building sector and as a result the supply chain must be matched to best service these alternative marketplace conditions. The Leagile strategy is expanded via different positions of the strategic stock, de-coupling point into four alternative strategies: Make to stock, fit out to order, shell and fit out to order and design to order. Each strategy is explained in depth and the paper concludes with a matrix designed to match these four alternatives with different customer requirements. Thus, a tool is provided for selecting the right supply chain strategy given any type of customer requirements.

KEY WORDS

UK house building, supply chain strategies, Lean, Agile, Leagile.

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INTRODUCTION

This papers original contribution to knowledge is an in-depth description of how supply chain management can be applied in the UK house building industry. The application of Leagility in the UK house building industry is explained and builds upon the research of Naim et al. (1999). Further, it is explained how alternative supply chain management approaches are applicable to different circumstances and the resultant development of an innovative matrix designed to match supply chain technique and customer requirements.

Supply chain management has been around for some twenty plus years, but it is only recently that cross fertilisation has taken place from its automotive and retail roots into the UK house building industry. However only parts of the philosophy has been applied to date, predominantly as a cost cutting tool. It has been recognised that companies no longer compete between one another, rather it is the supply chains that compete in the marketplace with all members relying upon each other in order to increase market shares and generate profits. Furthermore, there is no single supply chain management strategy that can suit all circumstances. As Shewchuk (1998) points out "One Sizes Does Not Fit All".

At present in the UK house building sector demand exceeds supply, therefore little or no consideration is given to customer requirements in relation to choice. House builders perceive an environment of 'feast and famine' (Ball 1999) therefore short-term financial results are paramount. As a result houses are completed to suit the requirements of the financial period rather than customer needs (Naim et al. 1999). Within such a context the first house builders that take a longer term perspective and offer choice to customers will reap the benefits. One further obstacle to optimising supply chains to best service the housing market place is quality. Efficient and effective supply chain management relies on the minimisation and management of uncertainty. However, poor quality, re-work and a shortage of skilled labour means there is a significant difference between the planned and actual activities.

The principles of Lean and Agile supply chain management strategies are explained in the context of house building supply chains. A combination of the two called Leagility is presented along with four alternative de-coupling point positions. Finally a matrix is developed that provides a framework for matching these alternative supply chain strategies to different customer requirements, so to overcome costs and ineffective mismatches of strategy and market place conditions.

UK HOUSE BUILDING VALUE STREAM

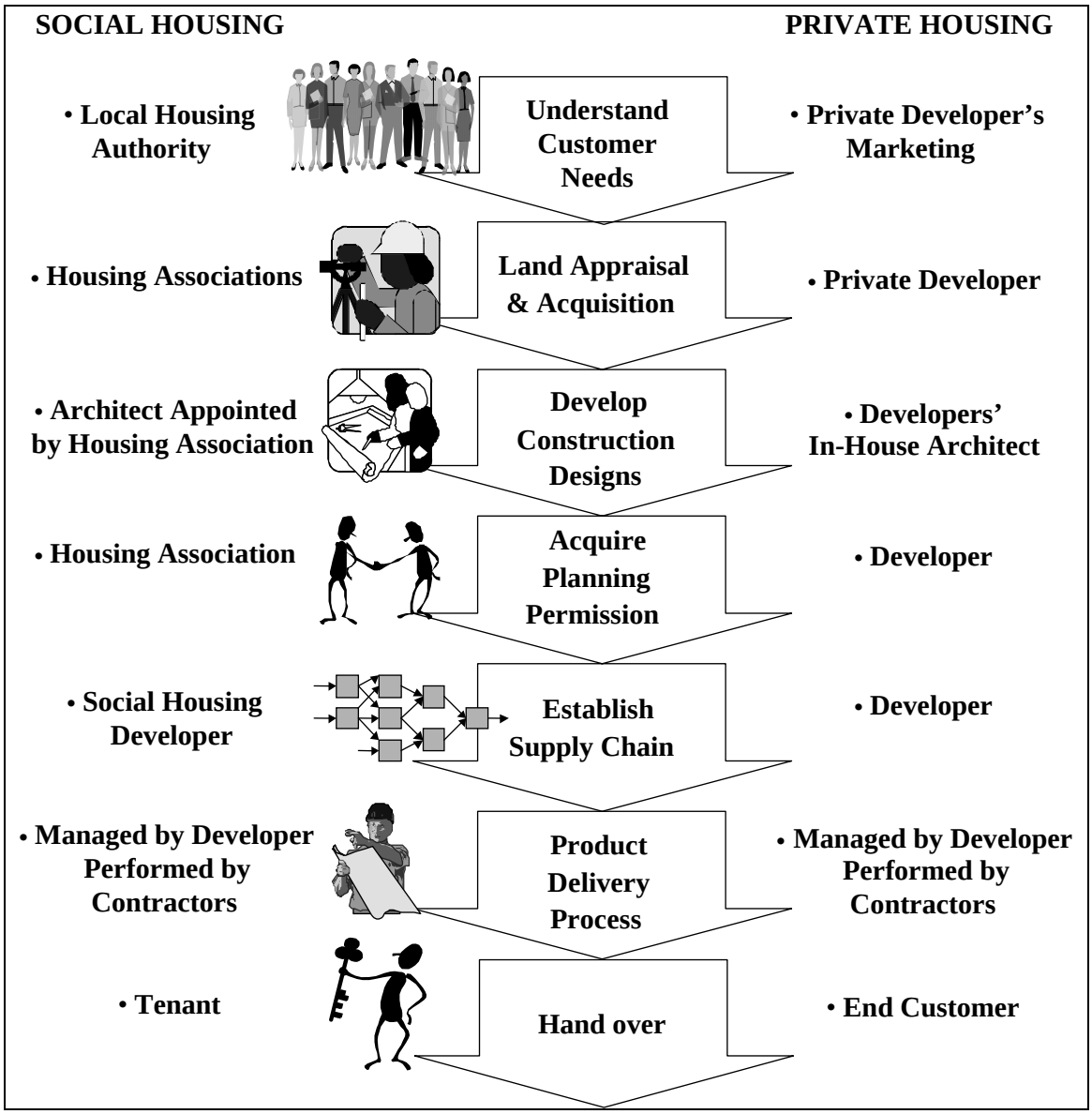
The definition for house building value streams used in this papers is as follows: *The holistic process from site identification and acquisition to completed construction of habitable dwellings including the design, establishment of the supply chain and control of the product delivery process.*

A generic value chain presently in operation within the UK house building sector is illustrated in Figure 1. Seven major stages are represented with the differences between social and private housing noted. Initially the demands of the marketplace must be understood, either by the local house authority in the case of social or by the marketing department of the private developers. The next stage is land appraisal and acquisition. In the case of social housing this is predominantly performed by housing associations whilst in private housing the developers appraise and acquire land themselves. Appraisal and

acquisition is carried out on the basis of speculative regional market demands for both social and private. Once specific sites have been purchased the next step is to draw design schemes for the housing development.

Generally, social housing associations appoint architects to design the new developments, whilst private developers utilise in-house architects to perform this operation. The preliminary designs are developed in order to apply for and hopefully attain planning permission from the respective local authorities.

Figure 1. Generic UK House Building Value Stream for Private and Social Housing



Once planning permission has been acquired the difficult task of establishing a supply chain takes precedence. In the case of social housing it is at this point that housing developers enter the picture, many of which have long term working relationships with suppliers of material and sub-contractors and therefore establish a supply chain for the construction of the dwellings using these contacts. In the same way private developers have built-up working relationships with key material and labour suppliers and establish a supply chain with these, depending on design specifications. In the ideal case long term partnerships are fully utilised at this stage, based on standardised building components (Barlow et al. 1997), in conjunction with industrialised off-site manufacture (Gann 1996). The penultimate stage of the UK house building value stream is the product delivery process, during which developers, both social and private manage the material, cash, resources and information flows in conjunction with on-site construction processes. The final stage is hand over, during which the end consumer, either the tenant or private buyer acquires the new development.

The generic value stream presented has a great deal of variants in practice, however the major stages hold for all house building projects. For example during some social developments partnerships have been built up between the housing associations and social developers, so they jointly perform the first three stages. Further, in some instances private developers are able to by-pass the first three stages because local authorities have already defined the private housing requirements and acquired planning permission. The remainder of this paper is focused predominantly on the final two stages of the value stream, i.e. establishment and operation of the supply chain and product delivery process. In this context the housing building supply chain is defined as: *The management, control and co-ordination of material, cash, resource and information flows in order to construct habitable dwelling based on specific design requirements, including the appraisal and selection of skilled labour and material suppliers.*

The objectives of supply chain management can be viewed as optimising equation 1 (adapted from Johannson et al. 1993), i.e. the maximisation of quality , service, heath, safety and environment, whilst minimising total logistical costs and total cycle lead times. Two commonly used supply chain strategies, lean and agile optimise this equation via alternative means, dependent upon customer demand.

$$\frac{\text{quality} \times \text{service} \times \text{health, safety \& environment}}{\text{cost} \times \text{lead time}} \qquad \text{Equation 1}$$

SUPPLY CHAIN STRATEGIES

At present there are two prevailing supply chain strategies, Lean and Agile. Lean has recently generated considerable interest in the construction sector (Tommelein 1998). Leanness as a concept has its roots in the Toyota production system and has been well documented for the automotive sector (Wommack and Jones 1996). Howell (1998) explains how construction under Lean is different from typical contemporary practice because it; has a clear set of objectives for the delivery process, is aimed at maximising performance for the customer at the project level, designs concurrently product and process, and applies production control throughout the life of the project.

Agility on the other hand has had minimal impact in the construction sector and has to date been predominantly utilised in the retail sector, especially for fast moving consumer

goods (Kidd, 1994). For the remainder of this paper Naylor et al.'s (1999) definitions for Leanness and Agility will be used; "***Agility*** *means using market knowledge and a virtual corporation to exploit profitable opportunities in a* ***volatile*** *marketplace*." "***Leanness*** *means developing a value stream to eliminate all waste, including time, and to enable a* ***level schedule***."

The defining difference of the two strategies is the variability in demand and therefore the circumstances in which they are most applicable (Childerhouse and Towill 2000). Evaluation of Equation 1 for customer value in relation to Hill's (1993) order winner, order qualifier criteria is illustrated in Figure 2. This shows that in the case of agility, availability and flexibility (Service level) to the consumer of products with unpredictable demand is the key order winner, whereas in the case of Lean, the key order winner is cost.

Figure 2. Market Winners - Market Qualifiers For Agile Verses Lean (Adapted from Mason-Jones et al. 2000)

	Market Qualifier	**Market Winner**
Agile	**Cost** **Lead time** **Quality** **Health, Safety and Environment**	**Service level**
Lean	**Service level** **Lead time** **Quality** **Health, Safety and Environment**	**Cost**

In most instances cost is the driving force and therefore Lean principles are most applicable. However, facilitation of customer choice means the demands on service level and therefore availability are increasing. In such a case Agility is required to respond to volatility and short delivery lead times. Further, self-build or designs to order housing is the extreme case were Agility is paramount. Demand for such housing is unpredictable and volatile plus, customers are only prepared to wait for a reasonable amount of time. Therefore responsive Agile principles are required. A third, new type of supply chain strategy is Leagility (Naylor et al. 1999). This is the combination of Lean and Agile principles.

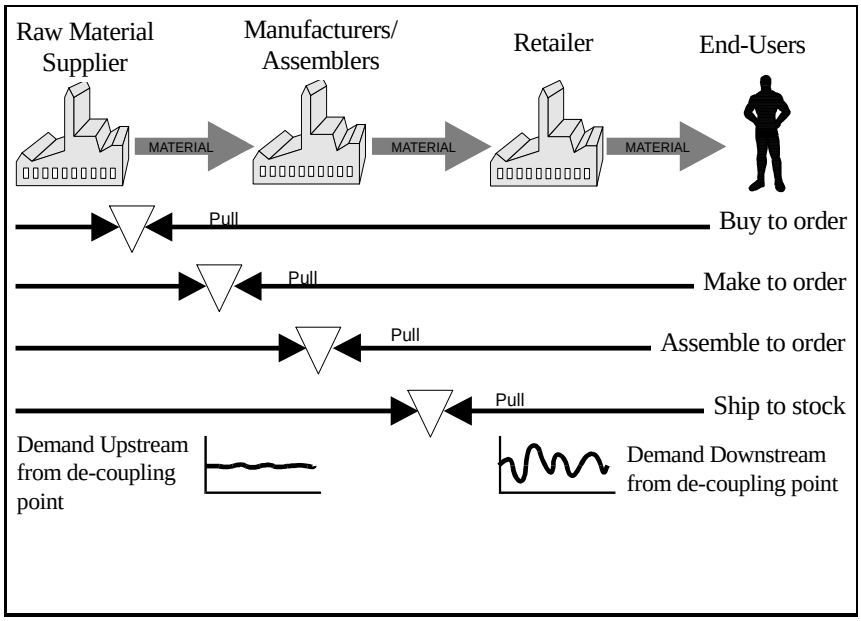
LEAGILTY

'Leagile' is defined as follows (Naylor et al, 1999):

*"**Leagile** is the combination of the Lean and Agile paradigms within a total supply chain strategy by positioning the de-coupling point so as to best suit the need for responding to a volatile demand downstream yet providing level scheduling upstream from the de-coupling point."*

Leagility utilises a de-coupling point. Four alternative positions for this strategic stocking point is illustrated in Figure 3. Those upstream (Left hand side) from the de-coupling point are buffered against the volatility in the market place and can therefore apply Lean principles. Whilst those downstream (Right hand side) must be Agile to cope with the market volatility.

Figure 3. Four Alternative Positions for the De-coupling Point (Hoekstra and Romme 1992)



STANDARDISATION

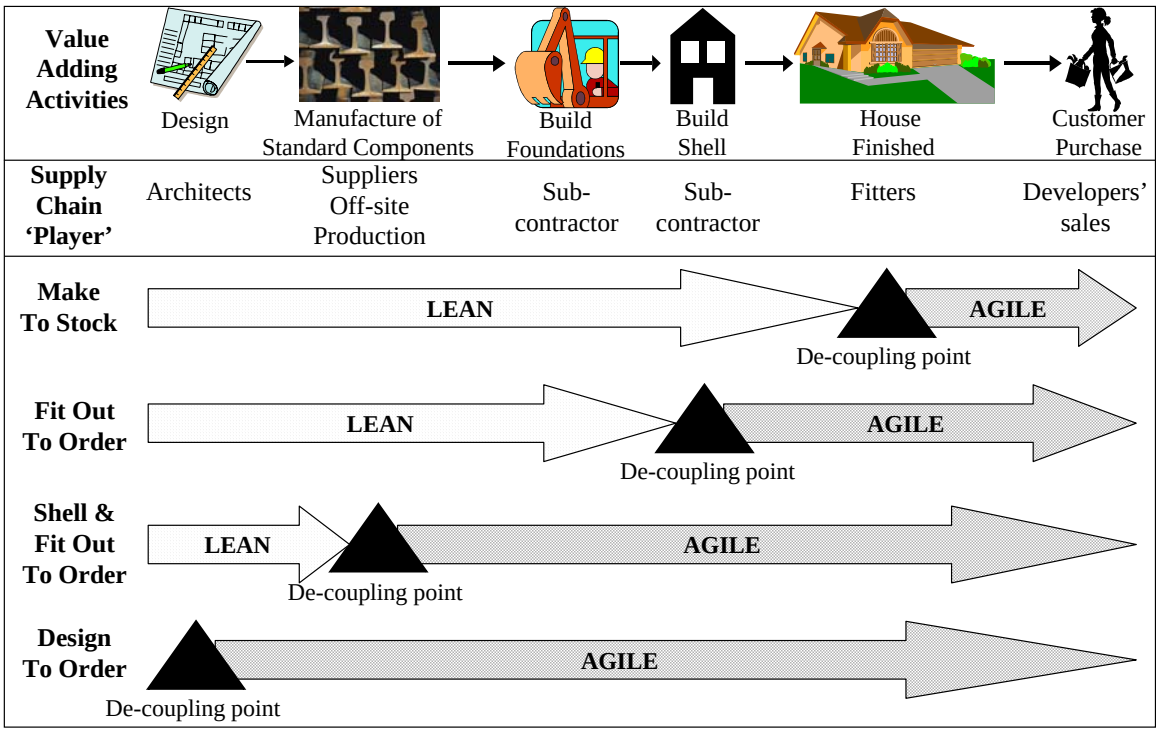
Central to the use of a strategic stocking point or de-coupling point is the application of standardisation, both in relation to components and finished house types. Indeed as Hooper and Nicol (2000) state "The scope for reducing costs through standardised building components and materials is heavily constrained by the extend of the deployment of standardised house type designs in the industry." Hooper and Nicol (2000) go on to define the most important characteristics of these standardised house types as the 'foot-print'. Therefore the application of standardised materials and house types reduces variety, ordering and stocking costs. The commonality of the building materials and components facilitates the use of the strategic stocking point because by combining the components in different configurations, alternative house types can be constructed thereby making customisation feasible.

FOUR TYPES OF HOUSE BUILDING SUPPLY CHAIN STRATEGIES

The question remains how can Lean, Agile, Leagile and the De-coupling point be utilised in UK house building supply chains? Figure 4 illustrates four alternative applications of these strategies in the context of house building. The differences between the four

strategies are predominantly the position of the de-coupling point, however the ramifications and advantages are far reaching.

Figure 4. Four Alternative House Building Supply Chain Strategies



Make To Stock

The first of the supply chain strategies illustrated in Figure 4 is when the de-coupling point is placed at the finished house stage. The traditional method for the construction of new houses is via this 'make to stock' strategy although without the sophistication of applying Lean and Agile principles. Houses are designed and constructed on the basis of forecasted (speculative) orders. Customers are offered choice on the basis of which alternative finished house they prefer, dependent on price, location, design and size.

These types of houses offer the customer no customisation and as a result marketplace competition is predominately on the basis of sales price. Therefore the design and construction processes must be made as Lean as possible so as to reduce costs. On the other side of the de-coupling point, during the hand over stage the ideal strategy is Agility so as to minimise the delivery lead-time in order to meet customer requirements and increase the speed of return on investment. In actual fact this cash flow starts earlier in many cases via a deposit before the construction is completed. One further factor that has to be overcome is the delay caused by customers being unable to move until their present home has been sold, in which case the cash flow lead time is further increased.

Fit Out To Order

The second of the supply chain strategies illustrated in Figure 4 is 'fit out to order'. In this case the de-coupling point has been moved one stage further up the supply chain. Shells are designed and constructed based on forecasted (speculative) demand. Customers choose between alternative shells and locations and once selected specify their desired fit out. This is then carried out on the basis of specific customer orders. Customers therefore have a degree of choice and resultant customisation via alternative fit outs.

Price is still the major driver of competition but is complemented via a degree of customisation. The processes leading up to and including shell construction must be as Lean as possible in order to be competitive via cost minimisation. The fit out stage on the other hand needs to be performed as Agile as possible, so minimising the delivery lead time to meet customer requirements. This is because customers are only prepared to wait a certain amount of time before they can occupy the dwelling. Once this strategy becomes widespread developers will compete on the basis of responsiveness in addition to cost and choice.

Shell and Fit Out to Order

The third type of house building supply chain illustrated in Figure 4 is 'shell and fit out to order'. In this instance the de-coupling point has been positioned at the standard components stage. Only the design and manufacture of these components are forecast driven. The foundations, shell construction and fit out are performed on the basis of specific customer orders. Customers therefore receive a large degree of choice. They can specify which of the shells and fit outs best suits their requirements for a given site. This is different to the present operating practices of most developers, who offer shell choice on the basis of pre-determined development planes, therefore customers may have to compromise on location because their desired shell is not planned for a given site.

Marketplace competition is now on the basis of customisation and price. Therefore, in order to best service this marketplace the design and manufacturing of standard components must be as lean as possible. Those stages after the de-coupling need to be Agile to deliver the finished house within customer lead time requirements. There is an issue with this strategy in relation to upstream processes. Within the UK planning permission can only be granted when specific frontages as a minimum have been specified, therefore reducing the capability to provide customised shells.

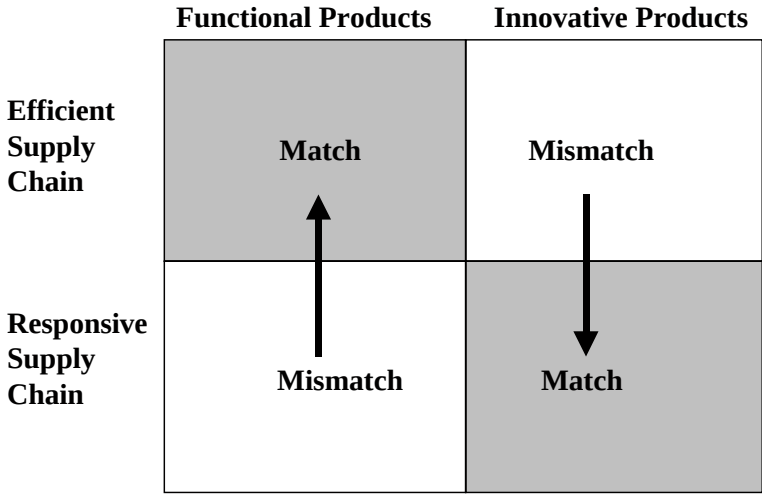
Design to Order

The final of the four supply chain strategies is 'design to order'. Figure 4 illustrates this type of supply chain with the de-coupling point placed at the design stage. The entire process is driven by specific customer orders, with forecasting having no part to play. The customer has total choice they can design exactly the types of home they require within financial constraints. As a result customisation becomes the major competitive advantage with price secondary but also of importance. The entire process needs to be as agile as possible so to meet customer lead time requirements and variety of choice. Self-build style homes can be categorised within this type of strategy.

MATCHING SUPPLY CHAIN STRATEGY & CUSTOMER REQUIREMENTS

Fisher (1997) explains the need to match your supply chain to your product. Figure 5 illustrates two extreme product types and related supply chain strategies best suited to maximise customer satisfaction. Efficiency is akin to Lean whilst responsiveness is best accomplished via an Agile approach. These principles hold for the house building industry, therefore developers also need to match their supply chain strategies to their customer requirements.

Figure 5. Matching supply chain strategy to product type (Fisher 1997)



The four supply chain strategies introduced in the previous section are not applicable in all cases. There will be circumstances in which one take precedence. Figure 6 illustrates a matrix for matching these four supply chain strategies to customer requirements.

Initially customer requirements need to be understood in relation to the degree of choice and resultant level of customisation (Ozaki 2000), as illustrated in stage one of Figure 1. Once this is achieved the most appropriate supply chain strategy can be selected by using Figure 6. The position on the horizontal axis is determined in relation to the degree of customisation required by the customer. Likewise the vertical scale is determined by the lead time requirements of the customer.

Customers that require homes within no lead-time and no degree of customisation are best serviced by a ‘make to stock’ strategy. When customers require a low degree of customisation in a short to medium lead time a ‘fit out to order’ strategy is appropriate. Customers who require homes in medium to long lead times with a medium level of customisation are best satisfied via a ‘shell and fit out to order’ strategy. Finally those customers who require a high degree of customisation and are prepared to wait for it are best serviced by a ‘design to order’ strategy.

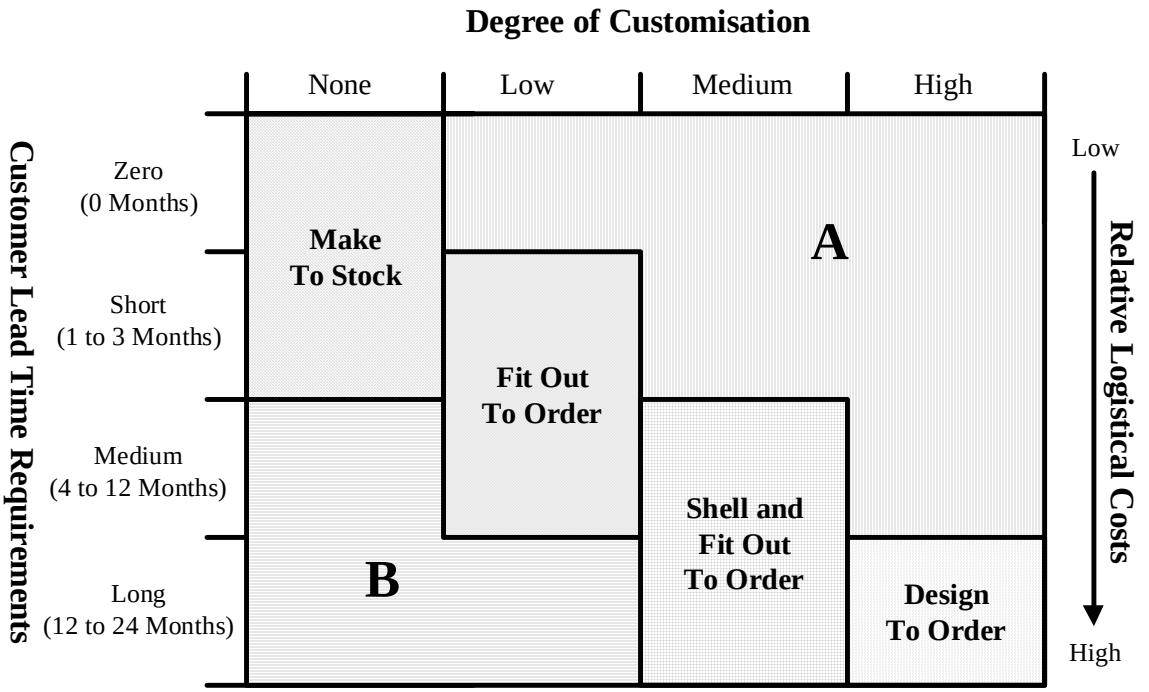
It should be noted that only 7 of the 16 possible combinations are feasible strategies. For example it is not possible to offer a high degree of customisation in a short or medium lead-time because of the design and construction of the houses can not be accomplished in such a quick turn around time; area A of Figure 6. Likewise offering

none or low degrees of customisation over a medium to long lead-time will rarely be acceptable to the consumer; area B of Figure 6.

Logistical costs are also a factor when satisfying customer requirements. Figure 6 indicates these logistical costs on the secondary y-axis. The more the house is customised the higher the relative logistical costs because of the additional costs associated with operating in an Agile manor, during which efficiency has to be weighed against responsiveness and resultant capacity utilisation.

In many cases a combination of strategies is required to service a varied customer base. As a result economies of scale are feasible via shared resources. However, care needs to be taken to insure conflicts of objectives for alternative strategies do not hinder the specific goals for each of the strategies.

Figure 6. Supply Chain Strategy Identification Matrix



CONCLUSIONS

The purpose of supply chain management within the UK house building sector is not only about the removal of waste and cost cutting. In modern day markets supply chains compete against one another, rather than individual organisations. As a result it should be the objective of supply chain management to satisfy customers as best as possible so as to achieve competitive advantage. Customers' demands are diverse and need to be met via the most appropriate supply chain strategies. Four such strategies have been presented along with the context in which they are most appropriate. The authors have a particular interest in the 'fit out to order' and 'shell and fit out to order' strategies as these are two new ways in which house building supply chains can operate. Customers want choice and the first companies to offer tailored homes that meet diverse customer requirements will become the market leaders.

The next stage of the research programme will involve the testing and validation of the 'fit out to order' and 'shell and fit out to order' strategies via action research. Particular attention will focus upon investigating the barriers for implementation and feasible components for standardisation. These findings will be summarised into a formal framework to aid implementation of these new customer focused strategies.

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