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THE IMPACT OF ECONOMIC AND SUPPLY CHAIN TRENDS ON BRITISH WAREHOUSING

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Introduction

Warehouses are key nodes in many supply chains and typically represent over 20% of logistics costs (Establish, 2010; ELA/AT Kearney, 2004). As a result, warehouses are often fundamental to the implementation of "smarter" logistics strategies, as per the title of this conference, and to the overall delivery of efficient supply chain performance.

Existing research on warehouses tends to fall into two distinct camps. Research by property practitioners, such as developers, investors or property consultancies, tends to focus on property market trends, particularly occupier and investment market trends in demand, supply and prices; whilst research by logistics academics tends to focus on warehouse operations and warehouse location planning. There has been comparatively little research which links actual property data on warehousing with wider economic and supply chain factors and which seeks to highlight how the actual take-up and occupation of warehouses by companies relates to supply chain theory.

The purpose of this paper is to examine this area in order to explore how trends in warehousing may relate to existing warehousing and supply chain theory so as to facilitate further research into the relationship between warehousing and "smarter" logistics strategies and efficient supply chain performance.

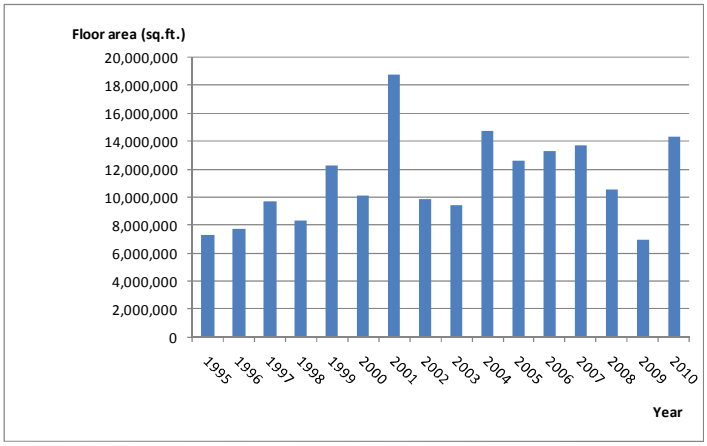
Research objectives and method

The paper is based on a longitudinal study examining the take-up for occupation of new large warehouses in Great Britain over the past 16 years, covering some 700 records. For the purposes of this study, new large warehouses are classified as being newly developed facilities of 100,000 square feet (9,290 square metres) and over in floor area (excluding mezzanine floors) and are simply referred to as "large warehouses" in the remainder of this paper.

Trends in the take-up of warehouse buildings are then related to wider economic, transport and supply chain trends and relevant logistics research.

Analysis and results

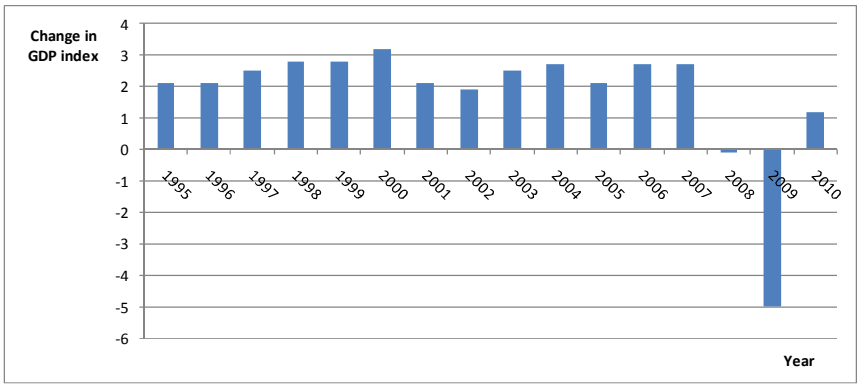
Figure 1 shows the take-up of new large warehouses between 1995 and 2010. Whilst annual levels of take-up fluctuated over this period, until the recession of 2008/09 there was a gradual upward trend in take-up.



Source: Jones Lang LaSalle

Figure 1: Annual take-up of large warehouses in Great Britain by total floor area

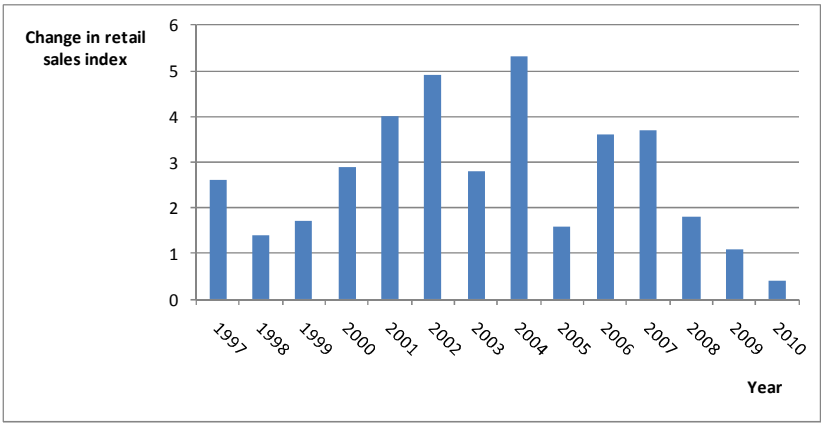
The demand for large warehouses in Figure 1 can be compared with trends in overall economic growth, measured by UK Gross Domestic Product (GDP), as shown in Figure 2. For example, the take-up peak in 2001 can be related to the previous steady increase in GDP growth which culminated the year before in 2000. Similarly, the take-up peaks in 2004 and 2006/7 can be related to the GDP growth peaks in the same years, whilst the recession of 2008/9 obviously had a major negative impact on take-up, as take-up slumped to a 16-year low in 2009. Interestingly, warehouse take-up recovered quickly in 2010 to a relatively high level, although data for the first six months of 2011 suggest that this recovery (like the economic one) may have stalled.



Source: Office of National Statistics (GDP at market prices; volume index)

Figure 2: Annual percentage change in UK GDP index

A similar pattern can be found in relation to retail sales, as shown in Figure 3. Rapid growth in retail sales occurred in 2001/2, 2004 and 2006/7, which can be related approximately to the three peaks in take-up mentioned above. However, it is noticeable that warehouse take-up increased in 2010 despite weak retail spending growth.



Source: Office of National Statistics (all retailing; volume index)

Figure 3: Annual percentage change in UK retail sales index

The general upward trend in the take-up and development of large warehouses is in line with the wider expansion of the warehouse stock in general, as illustrated in Figure 4. Across England and Wales the total built stock of warehouse floor-space increased by 22% between 1998 and 2008, whilst the built stock of factory floor-space declined by 8% over the same period. This change is likely to reflect on-going changes in the wider economy, including the growth of service activities.

Interestingly, the increase in warehouse floor-space of 22% compares with a growth in GDP of 28% in the same period. This increase in warehouse floor-space is much greater than would be expected from the simple application of the square-root rule, which would indicate an expected increase of 13% (Maister, 1976). Of course, nationally, many factors would affect this relationship such as changes in average lead times, transport reliability, inventory centralisation and warehouse technology (McKinnon, 2009).

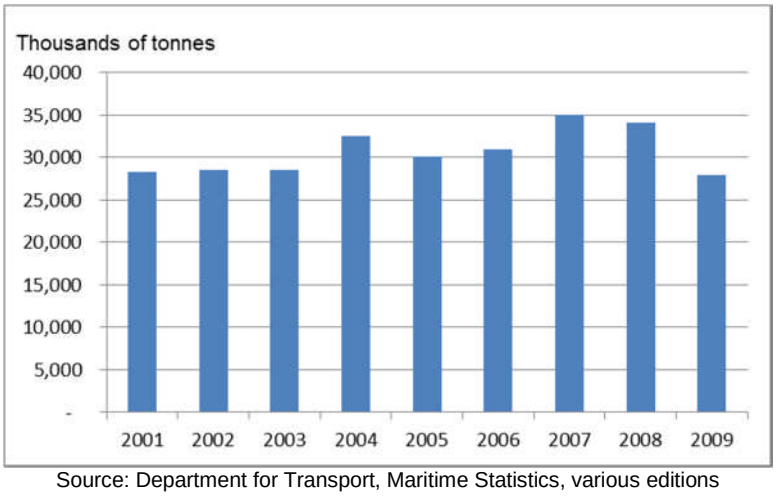
Source: ONS/VOA

Figure 4: Total built warehouse and factory floor-space in England & Wales,1998-2008

Separate data from the Institute of Grocery Distribution (IGD) (2011) highlight the increasing warehouse networks of the major food retailers. According to the latest IGD data, the three largest food retailers (Tesco, Asda and Sainsbury) have some 25 million square feet of UK warehousing between them compared with around 16 million square feet in 2000.

In general, therefore, the evidence suggests that the demand for large warehouses is related to the rate of economic activity in the economy. This is not surprising given that most goods that are produced and sold through retail outlets pass through at least one tier of warehousing, whilst even many service industries depend on warehouses to support their activities.

Globalisation could also have an impact on warehouse take-up, as longer lead times would tend to lead to larger inventory holdings to maintain the same service level (Waters, 1992). Thus, the sourcing of many items from areas such as Asia Pacific, rather than from domestic suppliers, would be expected to lead to greater inventory holding and thus an increased demand for warehouse space. Figure 5 shows the growth in UK container imports based on the tonnage of foreign traffic coming into the UK. The total tonnage of containerised freight brought in rose by 24% between 2001 and 2007 before falling back in 2008 and 2009 as the credit crunch and recession took hold and world trade contracted.

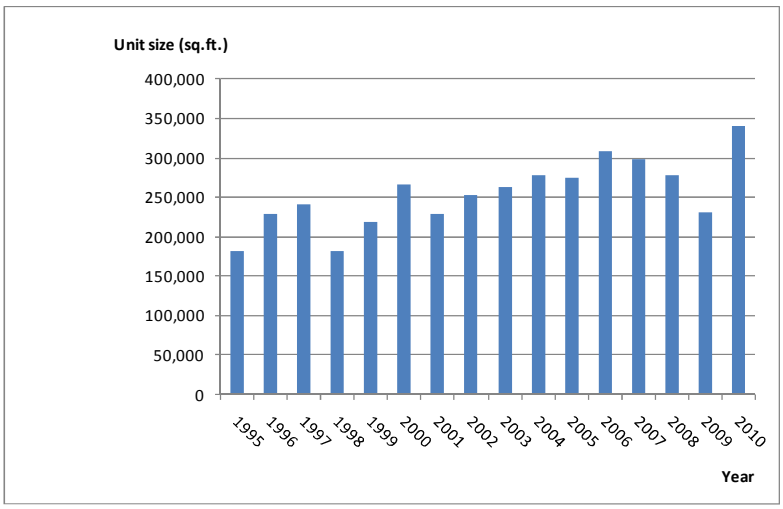


Source: Department for Transport, Maritime Statistics, various editions

Figure 5: Foreign container traffic into the UK

Other factors which may have had an impact on inventory, and hence warehouse floor-space, are expanding product ranges in terms of the number of Stock-Keeping Units (SKUs) and increasing market volatility (Christopher & Holweg, 2011).

Between 1995 and 2010, the average size of large warehouses grew from about 200,000 square feet to over 300,000 square feet, as shown in Figure 6. This increase in average size is partly attributable to an increase in the number of very large warehouses of 500,000 square feet and above, including a limited number of facilities of around 1 million square feet. This trend towards larger warehouses is supported by studies elsewhere in Europe, in Finland and Sweden (Hilomola & Lorentz, 2011).



Source: Jones Lang LaSalle

Figure 6: Average size of large warehouse units in Great Britain

In addition to increases in size, as a general trend large warehouses have increased in height. Based on the market experience of Jones Lang LaSalle, the typical clear internal height (to the underside of

the haunch) of a standard speculatively built new large distribution centre has increased from around 10m clear in 1995 to between 12m to 15m at present, as demonstrated by the recent examples in Table 1. This can be related to a recent survey by Baker & Perotti (2008) which indicates that 17% of UK warehouses use automated storage and retrieval systems (AS/RS) whilst a further 44% use narrow-aisle racking. Whereas the former tend to be built specifically for clients as high-bay warehouses, narrow aisle racking is suitable for use within speculatively built warehouses of 15 metre height. This gives better pallet per square foot utilisation rates than conventional reach truck operations of a lower height.

Scheme Name	Location	Size (sq.ft.)	Clear internal height / eaves height (m)
G.Park, Blue Planet	Chatterley Valley	385,000	15
415@ Lymedale Cross	Lymedale Cross	417,696	15
SIRFT, Unit 1 & 2	Sheffield	625,924	15
Prologis Park	Crewe	359,800	15
Drum One	Chester Le Street	263,885	15

Source: Jones Lang LaSalle

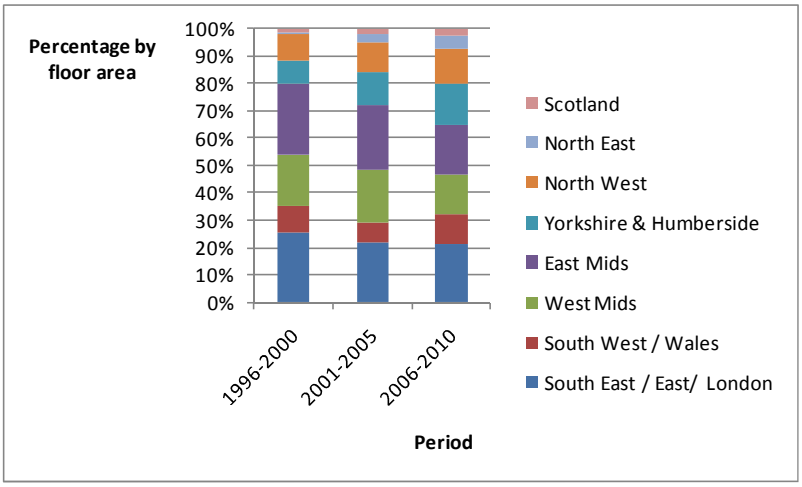
Table 1:
Examples of current speculatively built warehouses in Great Britain providing a clear internal height of 15 metres

This trend is interesting as there have been conflicting results from previous research on whether there are economies or diseconomies of scale in terms of warehouse size. Many of the empirical studies on this subject have been based on Data Envelopment Analysis (DEA) techniques which allow comparison between operating units with various inputs and outputs. Thus factors such as labour, space and equipment can be taken into account as inputs, together with units despatched, degree of accumulation and storage as outputs.

Factors that may lead to economies of scale include reduced management overhead, better use of space and labour by balancing workloads and the effective use of automation, whereas factors that may lead to diseconomies include complexity, the difficulty of managing a large workforce and the greater distances to be travelled within the warehouse. Pfohl et al. (1992) studied order picking areas and concluded that there were diseconomies of scale as large facilities required two-stage picking (e.g. batch picking and sortation) which needed more resource. However, in spite of this, they concluded overall that there was a slight cost advantage of large warehouses. However, Schefczyx (1993) found that large warehouses tended to be less efficient and this finding was confirmed by Hackman et al. (2001). McGinnis et al. (2002) found a slight positive correlation between size and efficiency, although a later study by McGinnis et al. (2006) found the opposite. From the scatter diagram of the latter study, it can be seen that both large and small warehouses may be efficient or inefficient and this probably has led to the contradictory results. Also, the use of DEA in the context of multiple inputs and outputs and with limited sample sizes has been brought into question and this may also be a factor (Simar and Wilson, 2008). Whatever the empirical evidence on this, there does appear to be a trend towards the acceptance of larger warehouses, as exemplified by Amazon's new distribution centre development of 1 million square feet at Dunfermline.

It is generally recognised that the "golden triangle" for the location of national distribution centres in the UK is around the East and West Midlands. As shown by Figure 7, in the period 1996-2000, 44% of new large warehouses taken-up were located in these regions; however, by 2006-2010 this figure had dropped to 33%. This change is likely to reflect a number of factors including the trend noted above towards large facilities which caused occupiers and developers to look beyond the established "golden triangle" to find suitably large sites with good access to labour. In addition, increasing fuel prices may have encouraged slightly more decentralised warehouse networks (McKinnon, 1998). It may also reflect an increase in on-line sales using postal services, where transport prices are not so sensitive to location, such as the Amazon example mentioned earlier.

Over recent years the significance of the "golden triangle" has also been challenged by the emerging trend towards port-centric logistics, which may include the use of warehousing at, or close to, a port as a way of improving the efficiency of a supply chain. For example, Asda and Tesco have both opened large import centres at Teesport, and DP World is currently constructing the UK's newest deep sea container port at London Gateway combined with Europe's largest dedicated logistics park to provide a significant port-centric platform. For many companies port-centric logistics has the potential to provide more efficient logistics solutions by eliminating many return empty container trips and enabling maritime containers to be fully loaded, thus reducing transport costs and carbon emissions (Analytiqa, 2007; Mangan et al., 2008). It may also facilitate time postponement (i.e. holding the goods at the port until it is known exactly where the goods are required).

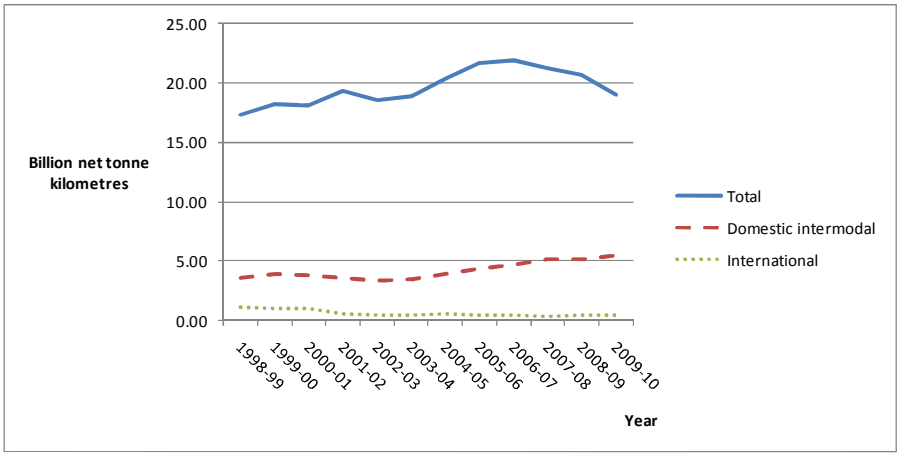


Source: Jones Lang LaSalle

Figure 7: Percentage of large warehouse space taken up by region

Most freight in Great Britain is moved by road. As a result, it is unsurprising that the location of large warehouses shows a strong relationship to the motorway and trunk road network and that motorway proximity is often identified as the main micro-factor influencing the warehouse location choice (Sleeman et al., 2003).

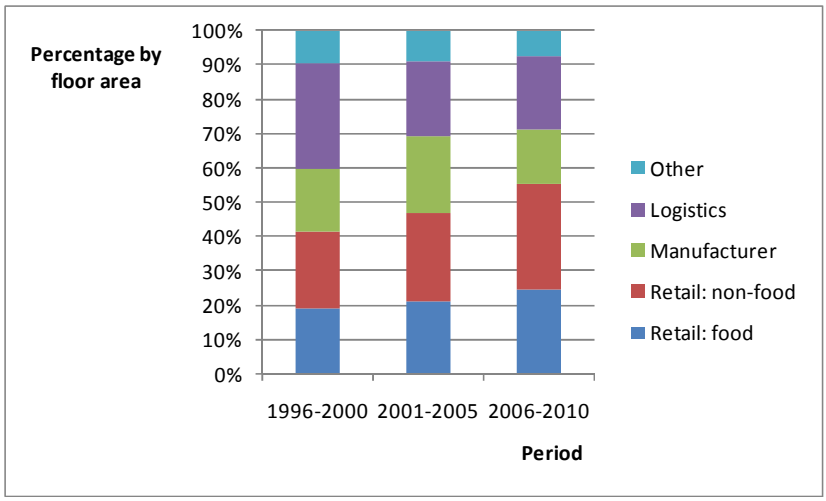
However, rail freight has grown since privatisation in the 1990s. Figure 8 shows rail traffic movements in Great Britain. The total figure includes bulk items such as coal, metals and construction materials. The figures for domestic intermodal and international may therefore be more relevant to general warehousing, and the former has shown a steady increase since about 2002. There has been much interest in the use of rail for environmental reasons, as well as for such reasons as road congestion and cost. However it is recognised that the lack of sites providing access to the rail network is a potential constraint on rail freight growth (Rail Freight Group / Freight Transport Association, 2008) and a number of recent proposals to develop Strategic Rail Freight Interchanges (SRFIs) have been turned down by the Government. The Daventry International Rail Freight Terminal (DIRFT) is the largest rail-connected distribution park in the country. This currently comprises some 6 million square feet of distribution space, including a number of facilities with their own dedicated rail sidings and proposals for the next phase of development at Daventry could add another 7.5 million square feet subject to planning.



Source: Office of Rail Regulation, National Rail Trends Statistics

Figure 8: Rail traffic moved in Great Britain

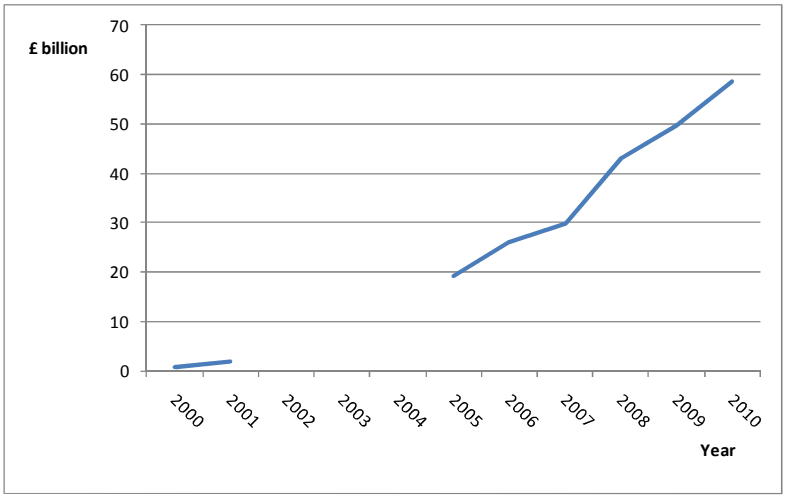
Figure 9 shows the trend in warehouse take-up by sector. In food and other sectors there has been a shift in power in the supply chain away from manufacturers towards retailers and this may have resulted in the growth in retail occupiers that can be seen. In addition, globalisation has probably had an important effect on the inventory holdings of non-food retailers. Much has been written concerning the growth in outsourcing (e.g. Jaafar & Rafiq, 2005) but the percentage take-up of large warehouses by logistics companies has actually declined. This may reflect a trend towards logistics companies being non-asset based and thus managing rather than owning or leasing warehouses on behalf of their clients. In addition, developers and investors which promote new warehouse buildings typically want occupiers to sign relatively long leases because lease length is a key driver of value. As a result, third party logistics companies, which often do not wish to commit to leases that are longer than their contracts, may encourage their clients to lease the warehouse facilities instead. Another factor may be the decline in the efficiency advantage that third-party warehouses used to demonstrate as in-house warehouses have become more efficient (de Koster & Balk, 2008).



Source: Jones Lang LaSalle

Figure 9: Percentage of large warehouse space taken-up in Great Britain by sector

One factor that has contributed to recent warehouse take-up by retailers has been the growth of on-line retail sales. As shown in Figure 10, UK on-line sales have grown from about £0.8 billion in 2000 to an estimated £58.6 billion in 2010 and further rapid growth is expected with the 'central' forecast from Mintel indicating that sales could reach £97.3 billion in 2015, which would represent 66% growth on 2010 (Mintel, 2011).



Source: Mintel: *Online Spending Habits*, February 2011

Figure 10: UK on-line spending

Discussion and conclusions

Data on total warehouse stock and on the take-up of large warehouses highlights the continuing importance of warehousing in supporting modern supply chains. Whilst supply chain theory and practice highlight the benefits of reducing inventory and substituting information for inventory (Christopher, 2011), the impact of any decline in inventory ratios would appear to have been offset by an expansion in real economic and retail activity, and the effect of extended lead-times associated with global sourcing.

The evidence suggests that modern warehouses have become larger, which suggests that economies of scale typically outweigh diseconomies, although at what size, or range of sizes, this may change is not clear. The academic literature on this point is inconclusive and it may well be that there are no clear economies or diseconomies of scale in warehousing costs themselves. The economies may be at the distribution network level, resulting from the centralisation of inventory and the “square-root rule” (Maister, 1976). As well as warehouses becoming larger in terms of footprint, they are also becoming higher. This is driven by the choice of warehouse equipment, particularly narrow aisle racking and automated storage and retrieval systems (AS/RS).

Warehouse location is clearly critical to supply chain performance and there are some signs that this may be shifting with a wider dispersion of new facilities than formerly. The development of ‘new’ supply chain strategies including e-commerce and port-centric logistics may reinforce this, as well as more practical issues such as labour availability and land costs.

New warehouse facilities built over the past 16 years have been predominantly road based but there is growing evidence that many leading retailers are developing their use of rail and accordingly seeking facilities that have the potential to be rail connected. This potential modal shift is being encouraged by rising fuel prices and an increasing focus on more sustainable logistics management. However, there have been relatively few warehouses constructed with rail sidings. Access to rail intermodal terminals may be more important.

There has been an increasing trend in the take-up of warehouses by retailers and manufacturers, rather than by logistics companies. Although there has been some increased interest in ‘insourcing’ rather than outsourcing, the figures do not necessarily demonstrate a trend in that direction in terms of logistics management. It could be that the increased take-up by retailers and manufacturers is due to the reluctance of logistics companies to commit to capital being tied up in warehouse buildings for dedicated logistics contracts that are normally far shorter than the life of the warehouse assets.

All of the above trends reflect the actions of companies attempting to improve their supply chain effectiveness and efficiency in these changing economic times. More research is needed to understand the exact nature of some of these trends and to identify precisely the supply chain scenarios when each warehouse policy may be appropriate. It is the intention of the authors that the exploratory research presented in this paper will provide a foundation and suitable insights for such subsequent research. This is particularly important for practitioners as previous research has noted that warehousing costs are to a large extent determined at the design phase (Rouwenhorst et al., 2000) and that "the impact of sub-optimal locations and poor specification have a direct impact on the cost of the operation using them" (Thompson, 2005, p.385).

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