

DON'T LEAN TOO FAR - EVIDENCE FROM THE FIRST DECADE

**Denis R. Towill - University of Cardiff
and
Martin Christopher - Cranfield University**

When the history of supply chain management comes to be written there will be at least a chapter devoted to the concepts of “lean” and “agile”. There has been much debate over the relative merits and de-merits of these ideas – some of that debate bordering on the theological. Definitions of lean and agile can vary significantly depending upon the point of view of the author or commentator. However, there can be little dispute as to the origins of these ideas in a supply chain concept.

Lean thinking can be traced back to the Toyota Production System (TPS) with its focus on the reduction of waste or ‘muda’. Initially seven forms of waste were identified: overproduction; waiting; unnecessary transportation; inappropriate processing; unnecessary inventory; unnecessary motion and defects (Ohno, 1988).

At the heart of the lean philosophy was the desire to “do more with less” leading to a more cost-efficient use of resources. To achieve this desired end a number of fundamental principles were advocated including level scheduling (haijunka) to achieve an even flow and the simplification of products and processes (Womack & Jones, 1990).

On the other hand agility owes its origins to the search for flexibility in manufacturing, particularly through automation technology (Goldman et al., 1995). Underpinning the idea of agile manufacturing is the search for the capability to respond to actual demand rather than planning ahead and making to forecast.

The principles of agility have been adopted and applied to supply chain management by a number of authors (Harrison et al., 1999; Christopher and Towill, 2000) as a means of coping with market volatility and uncertain demand. Christopher (2000) defines supply chain agility as a capability that embraces organisational structures, information systems, logistics processes and in particular, mindsets. It should also be emphasised that the need for agility extends beyond the focal firm to embrace the entire extended enterprise.

Leanness and agility should not be thought of as mutually exclusive ideas. Both have attractions as general business philosophies and indeed the view increasingly is that, wherever possible, they should be combined to create what some have termed ‘leagile’ solutions (Naylor, Naim & Berry, 1999).

Creating Demand-Driven Supply Chains

Whilst there are important differences between the lean and agile philosophies, in practice the real issue is about responsiveness.

Most commercial organisations today would aspire to being ‘customer-centric’. In other words they embrace the idea long espoused by marketing that the key to

sustainable competitive advantage lies in putting the customer at the centre of the business (McDonald et.al., 2001). Whilst few would challenge the philosophy of customer orientation that underpins this idea, its implementation has proved to be more problematic.

To be truly customer-centric, an organisation needs a supply chain capability that can be responsive to the different needs of different customers.

The problem is that conventional supply chains are designed from the 'factory outwards' rather than from the 'customer backwards'. Underlining traditional thinking on supply chain design has been the implicit objective of enabling the achievement of purchasing, manufacturing and distribution efficiencies. Thus the principle objectives of supply chain management have tended to be based upon the achievement of low-cost and hence more efficient outcomes for the company, rather than the satisfaction of specific customer needs.

It can be argued that today's market environment calls for a significant shift in the focus of supply chain management. The change in the balance of power in most distribution channels away from suppliers towards customers is now apparent and hence the need for supply chains that are 'customer-driven' rather than 'supplier-driven'.

A further reason why supply chains have to become more responsive is because volatility and turbulence in the wider business environment is growing. There are many causes of this volatility and turbulence. For a start product life cycles continue to shorten and the rate of innovation increases. At the same time product proliferation within a category is often growing faster than demand meaning that the volume of sales for individual variants is low and getting lower. All these factors combine to create a world where it has become harder to run the business on the basis of plans and forecasts.

To meet this challenge the organisation needs to focus its effort upon achieving greater responsiveness such that it can react in shorter timeframes both in terms of volume change and variety change. In other words it needs to be able quickly to adjust output to match market demand and to switch rapidly from one variant to another. To a truly responsive business volatility of demand is not a problem; its processes and organisational structure as well its supply chain relationships enable it to cope with whatever demands are placed on it.

Associated with the transition from forecast-driven to demand-driven supply chains is the move from make-to-plan (MTP) to build-to-order (BTO). Make-to-plan as a strategy is the traditional approach and is forecast based. On the other hand build-to-order implies a capability to respond to customer requirements in the shortest possible time frame. Sometimes a build-to-order strategy is based upon the principle of "mass-customisation" (Pine, 1993). Mass-customisation seeks to enable a demand-driven response whilst still maintaining the cost advantages of volume production through make-to-plan. The means to achieving this ideal combination is through a combination of lean and agile processes – lean processes to make or source the standard modules or sub-assemblies which are then configured or assembled in response to an actual customer order. The classic and oft-quoted example being Dell,

one of the world's leading manufacturers of computers and related equipment. This combination of lean and agile processes is at the heart of the "leagile" supply chain.

A Contingency Approach to Supply Chain Design

It is suggested here that the applicability of lean and agile approaches (and hybrid combinations) to supply chain design is contingent upon the specific demand and supply conditions.

Figure 1 suggests that a simple matrix can be derived based upon how 'lumpy' or 'smooth' demand and supply is for a particular product. Lumpy demand or supply suggests the possibility of discontinuity due to either market turbulence or uncertain supply. On the other hand smooth demand or supply implies that downstream and upstream variability in the supply chain is low.

(Take in Figure 1)

Depending on which of the four quadrants the company finds itself positioned – and a multi-product business will likely find that it occupies more than one – different supply chain design solutions are implied. These are briefly described below:

1. Lean

When both upstream supply conditions and downstream demand conditions are stable, then the focus should be upon achieving the most efficient flow through the supply chain. Examples of such lean supply chains might include staple grocery products, e.g. bread.

2. Agile

For these products where demand and supply are both highly variable a much more flexible and responsive supply chain is required. Classic examples where agility is required could be consumer electronic products.

3. Leagile

Where upstream supply is relatively stable but downstream demand conditions are variable the hybrid 'leagile' solutions may work best e.g. in fashion clothing.

4. Agilean

Whilst perhaps not so common, there will be occasions where downstream demand is stable but upstream supply is not e.g. wood products.

Table 1 provides some documented examples of the way these four solutions have been applied in different industrial contexts.

(Take in Table 1)

The De-Coupling Point

Fundamental to the marriage of the lean and agile principles in supply chain design is the idea of the 'de-coupling point'. Whilst the original concept of de-coupling related primarily to the material flow it is also important to recognise the related ideas of the

‘information flow de-coupling point’ and the possibility of the need for a ‘virtual de-coupling point’.

A. Material Flow De-Coupling Point

The decoupling point is a standard term given to the position in the material pipeline where the product flow changes from “push” to “pull”. It should therefore also correspond to the Order Penetration Point (Olhager et al. 2006, and Olhager, 2003). It is formally defined by Hoekstra and Romme (1992) as:

“The point in the product axis to which the customer’s order penetrates. It is where order driven and the forecast driven activities meet. As a rule, the Decoupling Point coincides with an important stock point ~ in control terms a main stock point ~ from which the customer has to be supplied.”

The material decoupling point thereby acts as a buffer between upstream and downstream players in the supply chain. This enables upstream players to be protected from fluctuating consumer buying behaviour. The consequence is a smoother upstream dynamics while downstream consumer demand is still met via an intermediate product pull from the buffer stock (Mason-Jones and Towill, 1999a). Figure 2 summarises the flow diagram corresponding to the foregoing material pipeline decoupling point definition.

(Take in Figure 2)

In suggesting that agility can only be achieved within a supply chain by concentrating as much attention on information flow as is traditionally devoted to material flow, we are building substantially on the early experiences of Stalk and Hout (1990). They specifically warn of the dangers of slow information lead-times, summing up the problems with information delays when they state “The underlying problem here is that once information ages, it loses value... old data causes amplifications, delay and overhead... The only way out of this disjointed supply system between companies is to compress information time so that the information circulating through the system is fresh and meaningful”. Overcoming these problems leads naturally to the concept of the “information enriched” supply chain (Mason-Jones and Towill, 1999a), which

contrasts with the “Traditional” supply chain in which everything happens sequentially.

B. Information Flow De-Coupling Point

Information flow does not have the same lead-time constraints as a production process and via IT it is now possible to reduce the information transmission lead-time from one end of the chain to the other to zero. *The main constraint to enriching a supply chain with market sales data is the common attitude that information is power.* As a consequence of the “traditional” culture, companies will often deliberately distort order information to mask their intent not only to competitors but even to their own suppliers and customers, unbelievable though this may seem (Pagh and Cooper, 1998). Figure 3 illustrates this point.

(Take in Figure 3)

Market sales data is the catalyst information for the whole supply chain, holding undiluted data describing the consumer demand pattern. Therefore the best way to ensure everyone in the supply chain gets the most up-to-date and useful information is to directly feed each level of the supply chain with the current market sales data. Managers should therefore be challenging and questioning mechanisms within the pipeline structures which appear to delay order transmission throughout the supply chain.

C. Virtual De-Coupling Points

In our discussion so far we have concentrated on “real” material flow de-coupling points which exist at the interfaces between “lean” and “agile” processes. In other words the fundamental nature of the ways of doing business changes. Typically, “lean” processes are driven by cost as the ‘Order Winner’. But “agile” processes compete on the basis of product availability i.e. responsiveness (Christopher and Towill, 2000). However in real-world supply chains the “lean” enterprise may well comprise a network of cost-competitive processes. The agile value stream may similarly be constituted from a number of responsive processes. *It is at the interface between processes of the same types where the “virtual” de-coupling points may be found.*

(Take in Figure 4)

There are a minimum of two pipelines within the supply chain associated with the material flow and the information flow. The authors argue that *both* flows have their own significant decoupling point, the strategic use of which differs due to the dynamic effect each has on the performance of the supply chain, (Mason-Jones and Towill, 1999b). Only by recognising this and strategically positioning both entities can full performance improvements be realised. However, due to the differences in the two pipelines the information decoupling point requires a definition of its own and is defined by Mason-Jones and Towill (1999a) as follows:

The point in the information pipeline to which the marketplace order data penetrates without modification. It is here where market driven and forecast drive information flows meet.

As illustrated in Figure 3 the order information pipeline decoupling point is where information turns from the high value actual consumer demand data to the typical upstream distorted, magnified and delayed order data. Holmström (1997) provides good examples of order transmission in two quite different value streams within the same European confectionary data. What is demanded from the factory is vastly different from current sales. Fortunately, the production scheduler takes an historical overview of this “turbulence” to partially smooth upstream material flows.

Traditionally, in supply chains this tends to be placed at the same point as the material decoupling point and is therefore placed as close to the end consumer as possible. This positioning is very wasteful and limits the effectiveness of the high value resource of undistorted order information available on the dynamics of the supply chain. *Therefore to maximise the strategic potential of these data within the supply chain, in direct contrast to the material decoupling point, the information decoupling point should be moved as far upstream as possible.* This enables upstream players to include within the ordering decisions the unbiased, undisturbed, rich information that is already available downstream. Hence there will be greater upstream market order penetration while leaving the point at which the supply chain directly responds to the customer (the material decoupling point) intact.

Figure 3 shows the material flow resulting from a strategic product and stock location review undertaken by Jones and Riley (1985). Four value-added processes (roll and plane; press lines; finishing operation; and packaging) are shown, with five stock location points completing the supply chain. Also shown are the relative value of the product at each location, the relative complexity at each stage, and the corresponding demand variation. Thus at the “front-end” the relative volatility and complexity both increase significantly (the latter due to the different combinations of artefacts demanded by an individual customer). In this example the review carried out by Jones and Riley (1985) established that the stocking policy (and hence associated replenishment rules) should be changed. Henceforth the major stocking point (which would now be recognised as the system material flow de-coupling point) is between the press operation and product finishing process, and *not* as previously as packaged inventory.

It is now obvious that prior to the material flow de-coupling point in Figure 4 the value-added processes are primarily “lean”. But thereafter the downstream stages must be “agile” if they are to be adequately responsive to customer need. With the old design, it would obviously be possible to have huge inventory at the product “packaged” echelon. Yet there could be an associated poor customer service level and many stock-outs because the wrong item is in stock as was reported in the UK pharmaceutical industry (Belk and Steels, 1998). Note that the remaining four inventories are “virtual”, in the sense that their optimum level is not determined by a switch in “modus operandi”, but by the needs of the associated processes, and in particular their geographical location and transit times between like activities. A more recent comparable leagile study has been undertaken in poultry supply, where there are added problems associated with optimum material flow de-coupling point location for any particular value stream. These include product perishability and the need for accurate trackability and traceability (van Dijk et al. 2001).

Conclusions

It will be apparent from the foregoing discussion that ‘real’ and ‘virtual’ de-coupling points play a crucial role in enabling lean and agile processes to be married in the way

most suited to the demand/supply conditions. Figure 5 seeks to summarise these ideas.

(Take in Figure 5)

It seems that the “lean vs. agile” debate has now run its course as the various protagonists have recognised that in fact there has been a growing convergence of thinking. Both schools pursue the same ultimate end – the achievement of ever-higher levels of responsiveness. Both are concerned with enhanced value delivery through the creation of appropriate supply chain solutions. This convergence is seen also in the real world of supply chain management where increasingly organisations strive to create agile capabilities based upon lean foundations.

We are also seeing the emergence of the idea that organisations will increasingly need to design and implement different solutions for different product/market circumstances. In other words supply chains will actually comprise multiple pipelines, each of which will be tailored to the specific market and product characteristics within which the firm operates.

This we see as the major challenge facing supply chain management in the future – how to create the conditions in which common building blocks (i.e. business processes) can be assembled in different ways to enable the appropriate blend of ‘leanness’ and ‘agility’ to be achieved in the face of the different contingencies faced by the firm.

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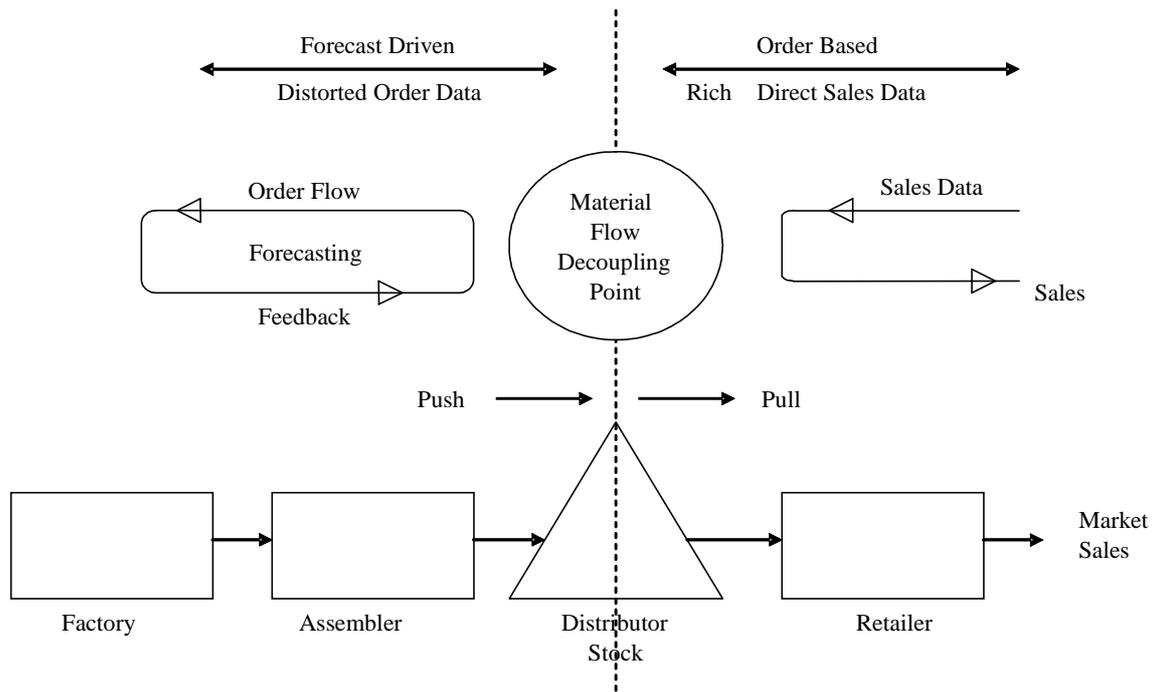


Figure 2
Representation of the Material Flow Decoupling Point
(Source: Mason -Jones and Towill, 1999a)

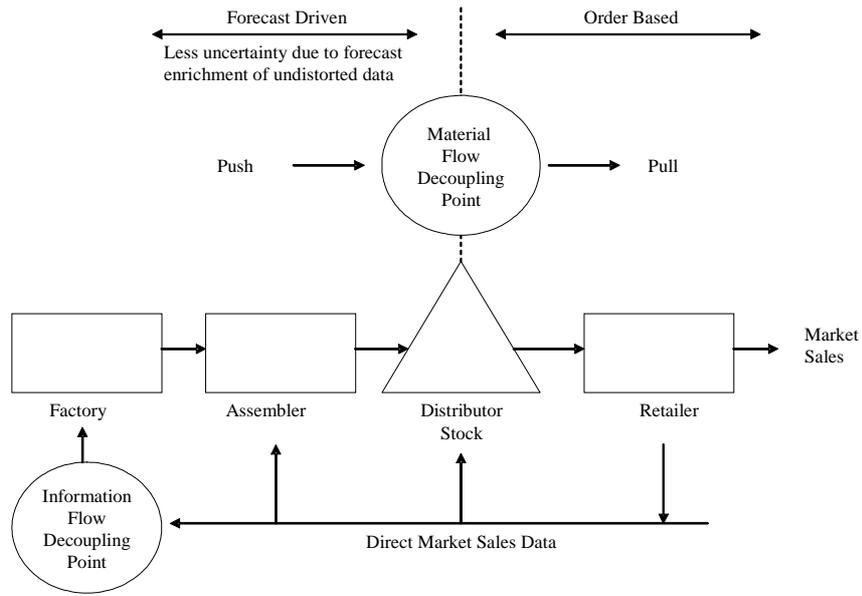


Figure 3
Comparison of Material and Information Flow Decoupling Point Positions
Within a Supply Chain
 (Source: Mason -Jones and Towill, 1999a)

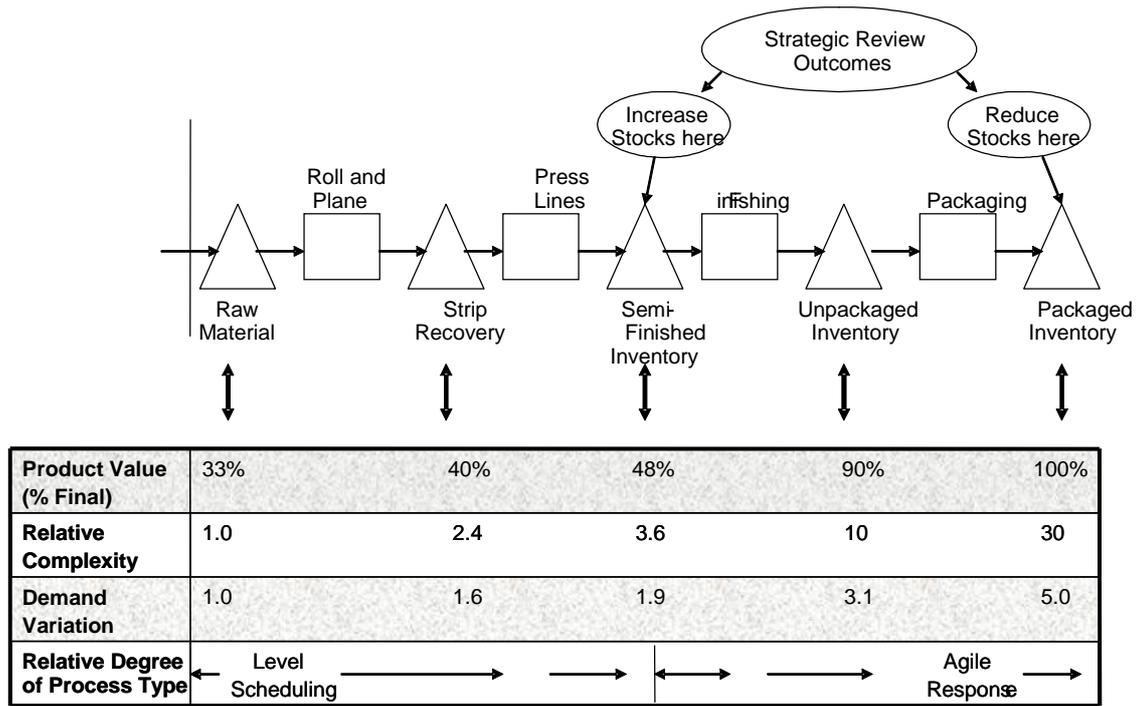


Figure 4
An Early Example of Strategic Stock Placement and Supply Capability at Different Stages in the Demand Chain

(Source: Authors based on Jones and Riley, 1985)