Transition from push to pull in the wholesale/retail sector: lessons to be learned from lean

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Abstract: The underlying aim of this paper is to investigate the implications of excessive accumulation of stock on the performance of wholesale/retail sector supply chains. The accumulated stock can clog the supply system and reduce new sales opportunities and profitability of business. This paper explores the implications of applying Lean Pull approach to address this and related stock procurement problems. It also discusses the margin and capital losses, which occur when performance data is aggregated to support decision analysis. The investigation shows how transition from push to pull can both reduce stock accumulation and improve the performance of total supply chain.

Keywords: accumulation; stock; lean; retail/wholesale; pull; buffer; manufacturing; decision support; supply chain; inventory.

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1 Introduction

The wholesale and retail industries form a vital link between manufacturing and the ultimate consumption of products by consumers. The requirement for greater flexibility in response to fluctuating demands is encouraging these industries to review their supply chain strategies and identify ways to save costs, stimulate sales and add value. These objectives were a driving factor in the research reported here on a wholesale/retail company seeking to identify inefficiencies in their supply chain. The aim of the researchers was to utilise an approach that had been successfully applied to high-volume manufacturing, Lean Engineering, to highlight inefficiencies (waste) in the business and then to apply a systematic waste elimination and cost-saving approach to addressing them.

The company that is the target of this research is medium-size company, which is partially retail but mostly dominated by wholesale activities. It supplies a wide range of consumer products including the electronic equipment and household goods, which are at the centre of this study and whose logistics are characterised by long lead times and bulk purchasing. Initial research carried out in the company had revealed that excessive accumulation of stock was seen to be a problem of high importance contributing to wasted activity and reduced stock value. This manifested itself as an excessive accumulation of stock at different points in the supply chain and reduced new sales opportunities and lowered the efficiency of the business in terms of both reduced revenues and increased activity costs.

The cause of this was traced to the aggregated impact of several inefficiencies including stock-holding decisions, obsolescence, long lead times and poor distribution across the supply chain. These factors also led to a loss of margins directly owing to the clutter with increased wastage (damage to stock) and low-priced clearance of unsold items. This excessive accumulation physically occurred at two places in the supply chain cycle, in logistics and distribution, and at the outlets. The initial investigation also revealed that in-store availability was perceived as a key driver to the senior management team and the cost of capital in, as yet, unsold stock as the major perceived loss. One of the objectives of the research team was to investigate this perception further, as the drivers for beneficial change would be strengthened if a fuller understanding of the costs to the business of excessive stock accumulation were realised. The researchers believed that there were additional significant losses, and that pricing, inappropriate buying and improper use of buffers were also critical loss contributors (margin loss = waste).

Investigation of the supply chain also revealed that there were major structural problems with the decision culture and the information system supporting it. Both of these were interlinked, as they were part of an interacting and evolving system, and operational decisions on these issues were critically dependent on the currency and precision of available data. The management information system, however, aggregated the data to facilitate periodic overall performance monitoring. This aggregation of data was endemic and adversely affected the operational decision-making at the point where margins and order volumes were determined. As detailed line data was not readily available to drive decisions, the currency of this aggregated was not seen as critical by the management team, and it had little impact on line decisions operationally. It logically follows that the buying and pricing decision timing was not critical because it was not informed and this resulted in weak decision-making and a leisurely pace of implementing

those decisions. As a result of this, the discount cycle employed by the company had a cycle decision time of months rather than days resulting in compounding the clutter in outlets with evidence of a very significant loss of margin.

To address the above-mentioned issues, greater awareness of them and a more systematic approach was needed by the company. The authors suggested that the Pull approach, which is a characteristic of the Lean philosophy, would help to address problems in decision-making and other inefficiencies in the supply chain. The Pull approach was suggested because in the situation described earlier most of these underlying issues were being adversely influenced by the Push approach adopted as company policy to load the outlets with stock for the upcoming sales cycle. The Pull approach in Lean provides autonomy of products being pulled by consumer (downstream) and not pushed by the supply chain (upstream). The adoption of Lean principles was also intended to address other process inefficiencies in the supply chain. The target was to streamline the business operations, accelerate the pace of innovation and raise the visibility of the issues needing to be addressed to combat the excessive accumulation of stock.

The information necessary for proactive decision-making was collected as part of the research activity to inform the decision-making policy and a Lean supply chain process was proposed to reduce non-value-adding activities in the total supply chain flow. Overall, the research provided a theoretical and analytical framework that developed a process for reducing the costs associated with inventory, obsolescence, long lead times and distribution. The primary phase was directed towards investigating the logistics and operations systems, and evaluating and validating implications of transferring lean principles to streamline them. The initial objective was to remove excessive accumulation of stock from the outlets to improve the sales environment and reveal the scale of the supply mismatches. The second phase was to evaluate and implement these principles throughout the supply chain to address some of the root causes of the problem.

The adoption of these Lean practices both helped to reduce the excessive accumulation of stock and identified the opportunity to improve margins. Both of these, of course, have a positive impact on profits. Also, the results obtained from the Lean models and trial outcomes validated the opportunity of using a Lean approach to addressing waste and lost opportunity in wholesale/retail supply chains.

2 Understanding excessive accumulation of stock

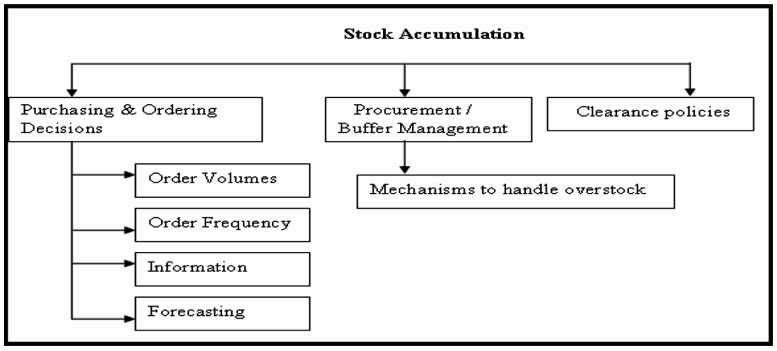
The research started with a detailed investigation of factors leading to stock accumulation and the parameters associated with it. The major factors identified are shown in Figure 1.

Factors influencing the points identified in the analysis of the company were:

- stock volumes to be purchased were set high to get good prices from suppliers
- the profit and margin determination was made in isolation from sales activity
- sales and other information were aggregated in company reports so that line item analysis was difficult
- operational and other costs of residual stock were not taken into account in measuring the success of the procurement and logistics operations

- limited formal mechanisms to handle the overstock situations and clearances
- internal lead time for promotion and pricing decision planning within the business was long
- lead time between order and delivery was long for overseas stock
- inefficiencies and lack of integration between suppliers, logistics service providers and company.

Figure 1 Sources of excessive accumulation of stock



The further analysis was undertaken to identify the most critical parameters relating to the accumulation of stock in the business (see Figure 2). These parameters formed the basis for further improvements and decision models. It was also anticipated that utilising these parameters would provide an effective Lean framework for future improvements.

Figure 2 Excessive accumulation of stock – critical business process

Impact of Stock Accumulation	Key Business Areas
• Reduced margins • Increased handling/processing • High stock holding levels • Higher shrinkage percentage • Low returns on capital • Low stock turns • Reduced Customer Loyalty	• Outlets • Central control/Buyers/senior management • Logistic service providers • Local suppliers • Overseas suppliers
Key Business Processes	**Key Performance Indicators**
• Buying/Purchasing • Ordering & Forecasting • Promotions • Physical Goods Flow/Procurement	• Stock Turns • Residue Percentage • Overstock Percentage • Operational Cost • Net margins • Stock Holding • Lead Times • Sales

Now that the major factors leading to the excessive accumulation of stock were clear. Further study was undertaken to explore the suitability of the Lean Engineering approach to reducing it. For this purpose, the methodology was studied in detail to endeavour to

understand which of the tools associated with it could be applied usefully to the processes that constituted the company's supply chain. Also, the emerging concept of Lean Retailing was studied to provide an insight into current trends in Lean initiatives in the Retail and Wholesale sectors. The cross-sector suitability of Lean discussed here is supported by work done by various authors in the field. The Lean Methodology was of interest because in sectors where it is well established its advocates claim that it can deliver:

- 45–75% Improved direct labour/productivity
- 25–55% Reduction in cost
- 60–90% Improved flow
- 50–90% Improved quality
- 60–90% Reduction in inventory
- 35–50% Reduction in space
- 50–90% Reduction in lead time (Jones et al., 2005).

3 Lean engineering/lean thinking/lean management: state-of-the-art

In manufacturing, Lean-based production techniques have resulted in overall improved performance of the enterprises, e.g., Toyota Production System (TPS). In the retail/wholesale sector, the approach is less common, and no generic set of tools, techniques and principles has been established. Industrial production is homogeneous in nature, integrating components in a predetermined environment, whereas the retail/wholesale sector is marked by continuous adoption of variable product lines with local autonomy in line composition. In the wholesale/retail sector, the most critical lead times are very close to point of sale in contrast to the manufacturing sector where the most critical lead times are on the supply side. Present Lean tools and concepts are, therefore, more likely to need to be attuned to reflect the differences that exist between manufacturing and the retail/wholesale sector.

Ahlstrom and Karlsson (1997) suggest that Lean is an integration of several different concepts under one heading. Sanchez and Perez (2001) describe Lean as a conceptual framework based on established practices, techniques and principles. Womack et al. (1990) introduced the Lean concept to operations beyond the shop floor and manufacturing environments. Hines et al. (2004) consider that the core objective of Lean is to provide customer value and introduce practices to support that provision. A Lean strategy in manufacturing aims to eliminate non-value-adding activities from the value stream to improve overall performance of the business. The main objective of the Lean philosophy is value creation, and in manufacturing, value is enhanced by eliminating waste.

There is a common perception that Lean is an 'automotive idea' and that is difficult to transfer to different sectors and, when there are major differences between the sectors, this is true to some extent (Crute et al., 2003). Arbos (2002) explains how Lean can be applied effectively to service industries and the level of improvement attained. His work provides a good analogy between the activities carried out in manufacturing and

service industry. Womack and Jones (1996) also highlighted the benefits of applying Lean principles in the organisations and supply chains in their book 'Lean Thinking'. It also reflects how elimination of waste both within a company and its supply chain can have tremendous effect on profitability and long-term prospects for the company. They condensed Lean thinking into five major principles:

1 Understanding waste

2 Setting the direction

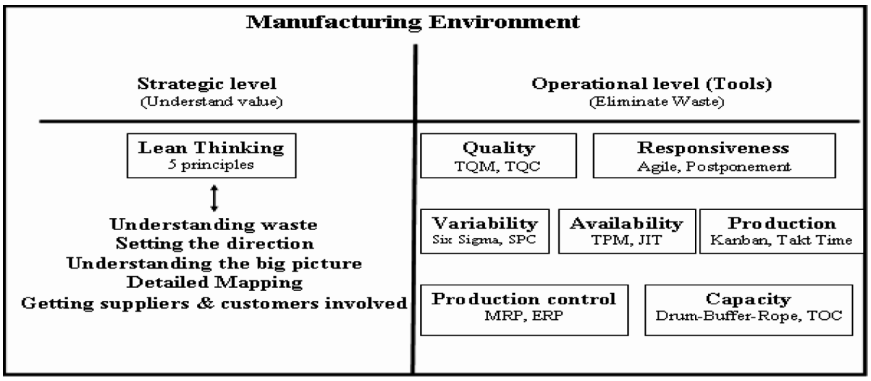
3 Understanding the big picture

4 Detailed mapping

5 Getting suppliers and customers involved.

The present tool set used in manufacturing described by Hines et al. (2004) is shown in Figure 3.

Figure 3 Lean tools in manufacturing



There is also a debate as to whether a Lean approach alone is sufficient to improve the efficiency of a business. Stratton and Warburton (2003) recommend that a holistic approach of combining Agile and Lean supply methods can be more effective for supply chains with high demand uncertainties. Agarwal et al. (2005) also suggest the addition of a combinational approach called Leagile supply and claims it to be more effective to address the problems in the supply chain. However, Hines et al. (2004) conclude that "Lean is still at its early stages of evolution in low-volume manufacturing and service environments". It is clear that the choice of which practices to be integrated into the Lean toolset depends on the areas of the business to be improved, i.e., production, quality, supply chain, cost, management and inventory (Jones et al., 1997).

3.1 Lean in wholesale/retail sector

The retail/wholesale industry has undergone dramatic changes in recent years. It has emerged as one of the most dynamic and hi-tech industries in the global economy (Cox and Brittian, 2000) and a variety of concepts and methodologies are used to gain competitive advantage (Newman and Cullen, 2002). Although these industries normally have well-defined strategies they are willing, and structurally, able to refocus and redirect

their business policies (Matchette and Lee, 2004). In recent business conditions, most of the leading companies in the sector have some sort of Lean initiatives underway. How far along they are and just what they understand Lean to be is difficult to know (Goodman, 2004).

Lean retailing is an emerging methodology adopted by US clothing and textile industries and Abernathy et al. (2000). They see Lean Retailing as aiming to improve the performance of such businesses by using information and related technologies to improve business performance but that although it is active in the US apparel industry it is still generally limited to that application. Lean Retailing demands are stringent with rapid replenishment and this in turn changes the operations of the business at various levels. The impact of Lean Retailing on manufacturers has compelled them to change their manufacturing practices. Manufacturers and suppliers in Lean Retailing have to reorganise their production, planning methods, cost models, inventory practices, production operations, workforce utilisation and strategies (Abernathy et al., 2000). Lean retailing needs more sophisticated demand forecasting, production planning and manufacturing strategies than those employed by traditional retailers.

The authors here have found no evidence of a systematic Lean approach or to the tools used in manufacturing being used in what is called Lean Retailing. Although the name Lean is being adopted for use of different information technologies, there is no evidence of a direct link between the original Lean manufacturing concepts and the use of these information technologies. The implementation of Lean, therefore, is seen to differ from industry to industry with no common set of tools and techniques being specified except for the manufacturing environment. There still exists a gap in cross-sector transfer of Lean. Also, the investigation revealed that there was an opportunity for a combination of different tools from the manufacturing sector to be used to develop the approach to addressing the problems in the supply chains in the retail/wholesale sector.

The approach adopted in this paper proposes to take Lean Retailing beyond the un-argued potential for the use of improved information technology. The work intends to additionally address the inefficiencies in the supply chain at strategic and operational levels. Further investigation was done to identify the appropriate tools within the Lean lexicon, which could be used to address stock accumulation. After studying the various Lean tools, the investigation lead to the conclusion that the pull approach suggested in Lean was best suited to address the problems in the target company. The attraction of this approach is that it tends to reduce the overstock (waste) by supplying the goods according to customer demand. The pull philosophy in Lean manufacturing requires that no upstream process should provide the goods or service unless it is demanded by the downstream process. This is supported by the feature that the pull approach when linked to waste analysis or value stream mapping encourages the reduction of lead times and inventories in the supply chain. In our case, the stock accumulation problem was mostly due to the imbalance between upstream decisions and downstream customer demand. The potential for adoption of pull practices along with the combination of different lean tools and implications of adoption on the business are discussed in more detail here.

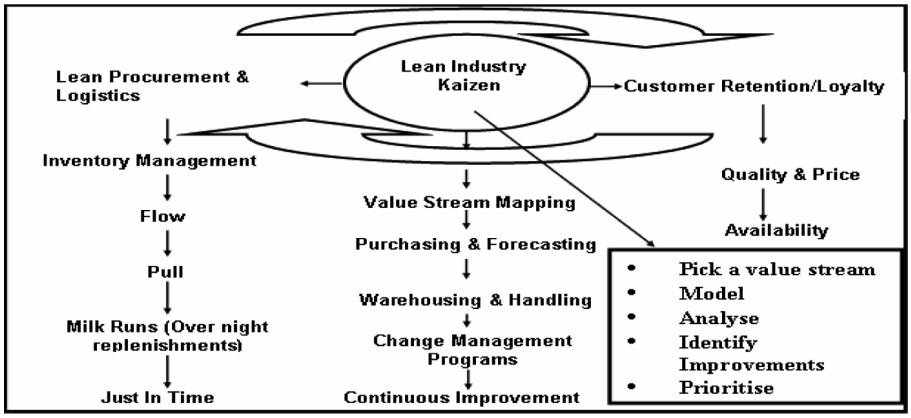
3.2 The pull approach to supply

The initial understanding of the excessive accumulation of stock was validated and refined by interviewing people at different levels in the company's supply chain. A collaborative approach was adopted to build a common problem definition and agree

on major factors leading to it. It was acknowledged that this accumulation was an area of major waste and reduced the efficiency and profitability of the supply chain and that the areas where major waste occurred were purchasing and forecasting, outlets, procurement and buffer management. Additionally, it was revealed and acknowledged that an underlying cause of this was the policy of pushing durable products to the outlets rather than the supply being pulled (demand led) in contrast to perishable goods, which were inevitably demand pulled. In the durable product supply chain, there was no evidence of a pull strategy being applied at any level.

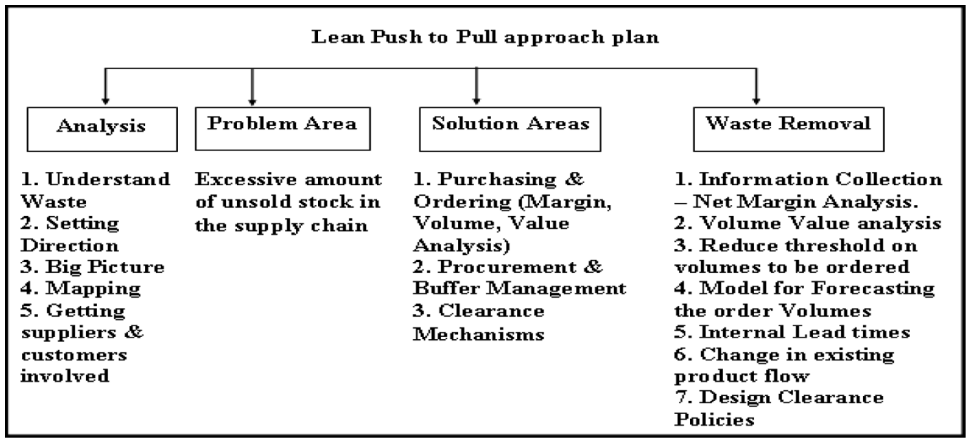
On the basis of the literature review outlined earlier, a Lean Supply Chain Model was developed (see Figure 4) using parallels from manufacturing to understand this excessive accumulation of stock. With the Kaizen at its core, the cyclic process aimed to use various lean tools taken from manufacturing to provide a systematic tool set able to be used to address the identified problems in the supply chains. The authors suggest that Lean supply paradigm should be a recursive process between strategic procurement and logistics (upstream), and customer (downstream). This would allow the flow of products to respond to customer needs, which would then ultimately result in customer satisfaction and hence retention and loyalty whilst simultaneously reducing stock accumulation and its associated costs in the business.

Figure 4 Lean supply chain model



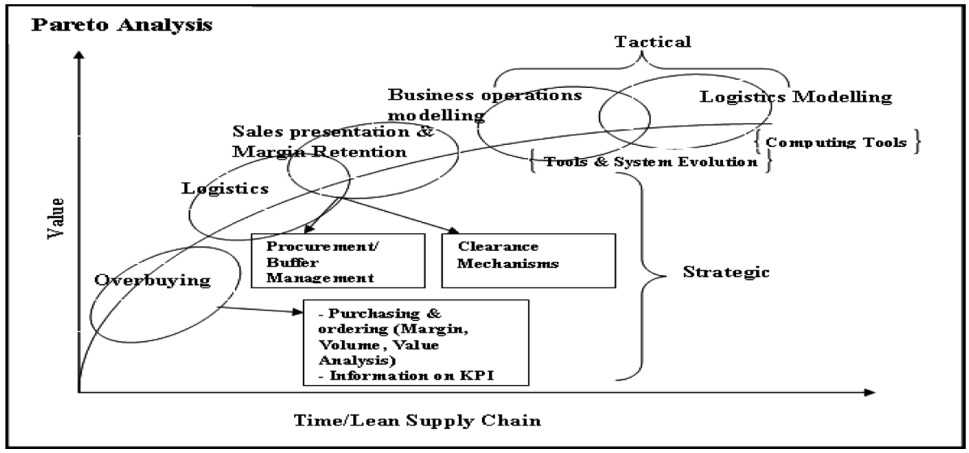
Contrary to the demand-led pull approach, the expressed belief in the company was that unless the stock was pushed onto outlets those at operational level would not make enough effort to sell it. This appeared to drive waste in the value chain and was directly contributing to the excessive accumulation of stock. It was clearly not a trivial matter to modify the underlying operating strategy of the business and so it was decided to approach the issue incrementally with a refinement of the push strategy, which distributed product against a predetermined schedule to each outlet to one that held back the stock that would otherwise become unsold clutter. The research suggested that incremental refinement to the existing push strategies could be used to develop a systematic Lean Pull approach plan as shown in Figure 5. This plan was based on the Lean Supply Chain Model mentioned earlier and the approach that has been successfully implemented in manufacturing. It was anticipated that implementation of this action plan would significantly reduce accumulation of stock in the outlets and verify that sales performance was maintained or improved.

Figure 5 Push to pull approach plan



This plan started with value stream mapping, which indicated various courses of action available to address stock accumulation. To prioritise these actions, they were set in a Pareto sequence as shown in Figure 6. This helped to identify the critical success factors, which would provide early wins. The authors suggested that overbuying was the area most able to show quick returns and influence stock accumulation at source. It was proposed that purchasing, margin, profit, value analysis and the development of Key Performance Indicators (KPIs) were the main parameters to be addressed. The second priority suggested was logistics, covering areas such as procurement, distribution, buffer management and clearance mechanisms. The third priority was to address the effect of first two on sales presentation including margin retention as a value-adding proposition rather than a waste reduction one.

Figure 6 Pareto analysis



These priorities needed to be addressed and sanctioned at a strategic level, as they challenged the underlying push philosophy. It was anticipated at this stage that investigation and improvements in these areas would provide an effective reduction

in stock accumulation, which would be self-validating and able to be introduced incrementally in most cases.

Once the investigation was done in these first three areas and appropriate measures were identified, research would be directed to the next element on the Pareto curve, which was developing the business model, to drive good behaviour. It was anticipated that the existing tools and information systems would require refinement in line with the proposed Lean operations. Also, it was more likely that some external modelling tools would be required to support the proposed business models. This Pareto-driven approach, based on a pull approach plan and lean supply chain model, provided a systematic guide to further research with the company, which is discussed later.

3.3 Overbuying: margin, value and volume analysis

Research was carried out in this area first, as it appeared on initial analysis to be a root cause leading to excessive accumulation of stock (waste). This investigation also revealed that promotional stock was at the heart of the problem, as this stock was supposed to attract customers into outlets, be sold within the sale cycle and leave no residual stock to be cleared. A key factor that drove this policy was the volatile nature of the stock, e.g., seasonal products and short-life electronics products. The failure to sell this stock within the given sales cycle led to directly stock accumulation, which was difficult to clear even with reduced margins and which competed with potentially higher margin new stock in the later sales cycles. The result was that these residues cluttered the outlets and reduced the net margins and hence profits of the business. This was driven by increased costs owing to double handling, damaged products and markdowns.

Data on this residual stock was not readily extractable from the database of the company and it was clear that this particular type of stock required further analysis to inform decision-making needed to direct improvement activities. This lack of focussed management information also hampered strategic decisions being made by company. The research revealed that decisions on stock purchase were made independent of the volume of related residual stock in the outlets. The decisions were mostly informed by the historical purchasing data and sales pattern of previous sales cycles. Also, in many cases, the purchase decisions were not discussed with individuals responsible for sales in the outlets. This resulted in the outlets being pushed to sell stock, which in reality they were not capable of selling.

A contributing factor in this decision cycle was the lack of information on the net profit made by a particular product line in the past through to clearance. The data was only analysed within the specific promotional cycle of the products and this was used to inform the purchase and promotion of similar products in future. The management data that was available aggregated groups of products and their associated margins and effectively hid the poor performance of the individual lines through to clearance. This aggregated product group margin was also used as a performance indicator for judging the quality of procurement decisions. Deeper analysis, however, showed that sales of new high margin lines were being offset by competing lower margin clearance products. This then resulted in high percentage of this new stock being left at outlets, which had to be marked-down in future cycles to clear it. This pattern was followed for months, rather than days, cluttering the sales floor in the outlets. Because the same policy had been followed for a number of years, the performance year on year was not

dramatically different though most product groups had seen an undiagnosed year-on-year reduction in the aggregated margin achieved.

The buyers' performance was assessed on sales achieved within specific promotion cycles and were not significantly influenced by the residual sales cycle of products. So, as long as the buying decisions led to a satisfactory minimum aggregated margin, the residue stock in the business was seen to be a issue for the outlets to deal with. With the capital tied up in unsold stock being an outlet performance measure, their failure to contain stock levels drove their requests to further reduce margins to clear. This pattern of behaviour also had a potentially major impact on customer buying behaviour. Given that there was no intermediate storage facility; all the stock received from supplier was directly sent to the sales outlets. Thus, the customers were aware of the actual amount of stock in the business. This might develop a tendency amongst customers to wait for the clearance and to buy the products at cheaper prices in the after-promotion sales cycle. All these factors led to a conclusion that a system was needed to keep the outlets clear of excess stock and ideally to switch to pull-based supply order to reduce excessive accumulation of stock in outlets and potentially to enhance retained margins.

Such a move would be more likely to impact on a large number of areas within the business requiring changes in buying, logistics, information systems, performance metrics and underlying operating philosophy. It was clear that a staged approach was required to reform the operations without too much disruption and to facilitate a buy-in to the change programme indicated by the research. Each step in the change process should be evidenced based with emerging issues from implementation informing subsequent decisions, which has long been recognised as being at the heart of Lean practices (Womack and Jones, 1996).

The value chain mapping started with an analysis of existing management information on the stock feeding stock accumulation. In the initial stages, the data was analysed to study the commercial impact of the excessive accumulation and the push strategy being followed. A sample product group was taken to study its promotional sales cycle, and residue pattern, with the data on sales and residue stock being analysed for same product group in different promotions for one complete year (see Figure 7). It should be noted that for reasons of confidentiality throughout this paper all values are plotted on an arbitrary currency scale. However, it can be seen that the influence of the accumulation of stock is clearly visible from the pattern. In an ideal scenario, to have reduced accumulation (waste), the sales value should be high when compared with residue stock. The pattern established highlighted that no such pattern was followed and that the purchase cost of residue stock routinely exceeded sales income with the consequent excess being left unsold in the outlet waiting for future clearance.

The pattern shown in Figure 7 confirms the accumulation effect and is consistent with the factors discussed earlier. The further data analysis was carried out to study the complete cycle of specific products by mining the company database. This analysis showed that with the data being presented in aggregated form to measure the success of particular product groups failed to reveal significant line margin degradation over time. The effect of this can be clearly seen with the typical product line sales pattern shown in Figure 8.

Figure 7 Sales vs. cost of residue stock

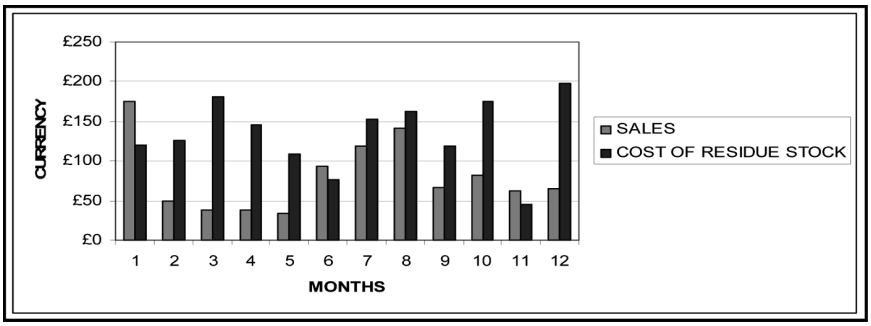
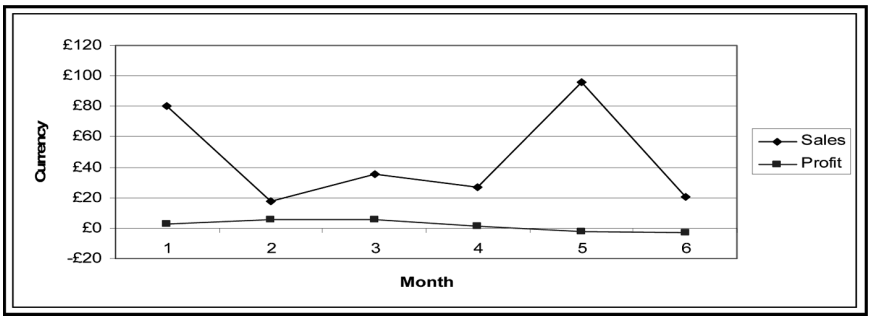


Figure 8 Overall profit analysis



The waste owing to aggregation of information can be explained with the help of Figure 8 and Table 1. The data for one of the congested product lines was studied for six months after the end of promotion in which product was launched. Analysis of the sales and profit trend of the above, and other, product lines led to the conclusion that although the product was sold below cost price (negative profit) after certain point, i.e., month 4, the overall profit made was positive. This might be seen as a successful outcome; however, this aggregation of data disguises the impact of not only a significant accumulation of stock of unsold stock over a number of months but also a loss of retained margin. Had the stock become exhausted at the end of month 3 then the overall margin would have been 9.7% on sales of £133 with capital required to purchase the original stock more than halved. With this pattern repeated over most of the special purchase lines, the impact of this aggregation on the business is shown to have a significant effect on business performance over and above the immediate problems resulting from clutter of unused capital (low stock turns), additional handling and wastage. This pattern provides direct evidence of stock not being pulled by the customer but being driven by the buying decisions.

Table 1 Overall profit analysis

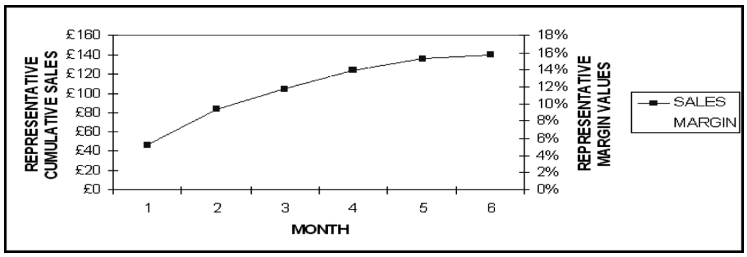
Month	*1*	*2*	*3*	*4*	*5*	*6*	*Overall*
Sales	£80	£17	£36	£27	£96	£20	£277
Profit	£3	£5	£5	£2	–£2	–£3	£10
Margin	3.31%	30.74%	15.24%	6.12%	–2.07%	–13.60%	3.73%

It is argued here that this data aggregation is one of the major factors contributing to over-purchase and hence waste. The information system in place aggregated the data to provide performance monitoring in reasonably succinct management reports. This aggregation, which was prevalent across the business, hindered the operational decision-making at the point where margins and volume were determined. As the data necessary to drive good decisions was not readily available, its currency was not critical and it had no impact on the decisions. It also revealed that the decision timing was not critical because it was not informed. This then encouraged the early decision-making to facilitate forward planning with a leisurely pace for implementing those decisions. As a result of this, the promotion and discount cycle on product lines was running with a cycle time of months rather than days with evidence of a very significant loss of margin as those decisions were not informed by detailed and current sales analysis.

It was recommended that the individual product lines should be monitored, analysed and reported routinely as an integral part of the product line management process. The planned end of the sales cycle for the given product line should be when its margin reduced below target. In the above-discussed scenario based on Figure 8 and Table 1, month 3 might be an ideal point for the end of sales cycle with residual clearance if any in month 4. This would not only improve the retained margin and profits but also reduce the cost of capital and ultimately the physical volume of the stock, i.e., excessive accumulation of stock.

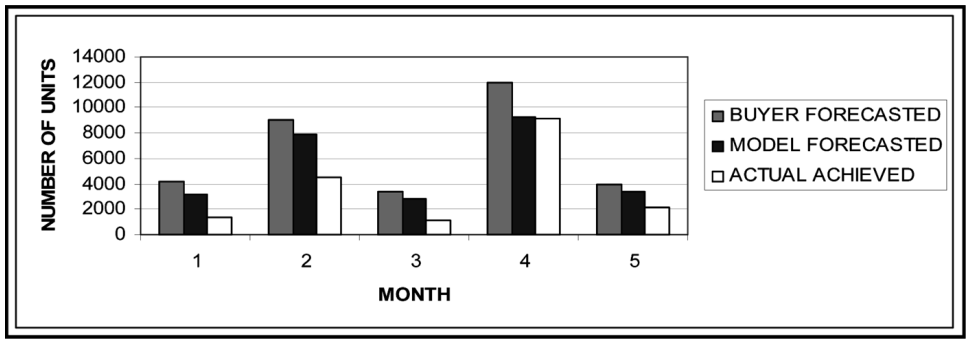
The other inefficiency related to information collection that was identified was the internal lead time for information. To highlight this problem, a product line was chosen and its sales and margin pattern was analysed as shown in Figure 9. This was a generalised pattern followed by most of the products identified as leading to excessive accumulation of stock. Figure 9 shows that although the given product was selling well at higher selling price in month 2, yielding a high margin, the price was reduced in the following month reducing its sales and margin. This was because the decisions on pricing for the next sales cycle were taken before the data on the current sales cycle was available. A factor that forces this decision timing is a sales promotion cycle, which is longer than interval between sales cycles. Although the product was yielding higher margins in month 2 the business was not in position to alter the price for month 3, which had already been set. To enable the promotion system to be responsive to customer demand, it is necessary to allow the line promotion and pricing decisions to be informed by the immediately preceding sales. This would require the promotion cycle to be substantially less than the sales cycle. However, as the current line information was not available, and with the promotion performance measured by sales volume and not margin, there is little incentive for the players to reduce lead times on their decision and commit cycle for promotion.

Figure 9 Sales vs. margin analysis



Once the above-mentioned inefficiency had been identified, there was a need to establish the optimum stock level for the given product lines to identify the point of maximum profit and minimum overstock, i.e., waste. The above-mentioned inefficiency (waste) in the availability and hence use of information was discussed with the business. Given that a radical change in the information system was not feasible in the short term, it was decided to develop a decision guidance tool in the form of a sales performance prediction to enable the buyers to decide on the optimum volume of stock to be bought to reduce excessive accumulation of stock and maintain retained margins. The model was developed taking two top-level constraints into consideration, first was no loss of sales within the target sales cycle and second was minimum residue stock consistent with the first constraint. To develop such model, the historical data and sales, profit, margin scenario was investigated for the product lines leading to excessive stock accumulation. The data was analysed and investigated for previous three financial years. The model also took shrinkage and markdowns into consideration for forecasting purposes. The forecast model output and trials outcome is shown in Figure 10.

Figure 10 Forecast model



Although the model was not pull-based, the forecast model developed using this information enabled the authors and business to identify clear opportunities for reducing the stock to be purchased as a first step. The model was tested for one product group in a blind test for five months and the results are as shown in Figure 10. The results show that the model did facilitate a reduction in the purchased volume in stock causing excessive accumulation (waste) in the business. However, it can also be seen that this tool was not able to be precise, as it is based on historical trend and is deliberately conservative to provide a high level of assurance of no stock-outs within the sales cycle. Even given these constraints, the trial demonstrated the potential to reduce capital committed to stock by 19%. The reduction in quantities of residue stock also promised higher retained margins and profits in addition to the capital savings. Also, it was anticipated that the reduced volumes in the outlets would provide an opportunity to provide better presentation and more sales area to high demand products.

3.4 Procurement/Buffer management

The second important area on the Pareto curve, which was having high influence on excessive accumulation of stock, was the supply logistics. However, the effective the impact on excess stock that could be made by improving purchasing and forecasting,

the more the Lean initiatives were required operationally, as the accumulation was a combination of several inefficiencies. The second stage was to optimise the flow of product to try and optimise stock allocation to the outlets. Although the volume of clutter could be reduced by a forecasting model, improper allocation still left some outlets with unwanted stock and potentially others with stock-outs. The expenses incurred in moving this stock locally between outlets were very high and not profitable to the business. This misallocation of stock was compounded by a policy of not using intermediate storage in the supply chain. This issue was most problematic with stock coming from the overseas suppliers where consolidation for each outlet was done at source. The decisions on consolidation and allocation to each outlet were, therefore, required to be taken in well advance. The company had chosen not to have a buffer system in the UK to allocate the stock to the outlets immediately prior to delivery owing to the perception of increased operating cost. The operational philosophy, as discussed previously, was one of the push-based supplies and so the push-based consolidation overseas was consistent with this even though these decisions were constrained to be made months in advance.

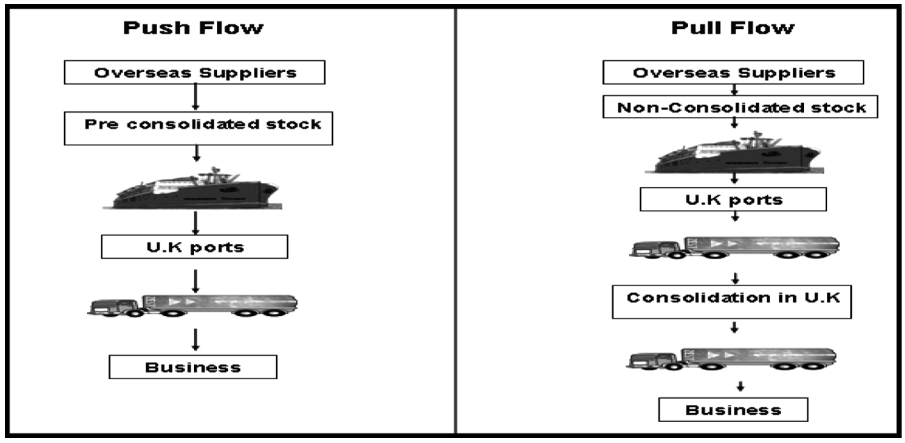
This strategy of course contradicted with Lean philosophy, which is based on pull mechanisms rather than push and does not seek to eliminate buffers unless they are not adding any value to the business. In other words, the improvement of operational activities should aim to reduce the need for intermediate buffers but those that improve resource allocation and reduce waste should be retained. An investigation was carried out to understand whether the cost of having a UK-based consolidation and buffer store would add benefit to the operation. This study suggested that the introduction of such a central buffer system had the potential to significantly reduce the accumulation of stock in the outlets and direct stock flows towards outlets selling the lines. This also revealed that to operate this effectively there was a need to transform the existing push-based outlet stocking operations a re-supply pull system.

The aim of establishing a central buffer system was to cut out direct deliveries to the outlets from overseas. It was anticipated that implementation of this type of system would enable management to allocate stock coming from overseas in more effective manner. The major benefit of this system was for the outlets because with such system they would not need to accept stock irrespective of sales. It also provided autonomy to the outlets where stock could be stored offsite and pulled into the outlet in multiple overnight waves on a Milk Run basis when required. It was also anticipated that introduction of this system would also give outlets an opportunity of increased floor space availability to improve presentation and sales. It might also enable extension of stock lines, if appropriate, within a given outlet floor area.

The proposed pull-based system and the differences between it and the existing push system are shown in Figure 11. The proposed system was a Lean central distribution system in UK based on Just In Time (JIT) deliveries with overnight Milk Runs. The difference suggested was that instead of consolidating the stock overseas stock was brought to the UK and then consolidated. The central distribution would also enable the business to realise transportation consolidation efficiencies. This would also make the supply system more transparent increasing the inbound flow visibility and control. These benefits, in turn, would also help the outlets to plan their shop floor sales activity more effectively, as they could be expected to sell more with improved presentation. This would also create a better selling environment for customers reducing their existing tendency to wait for clearance as a result of the more controlled buying practices with the

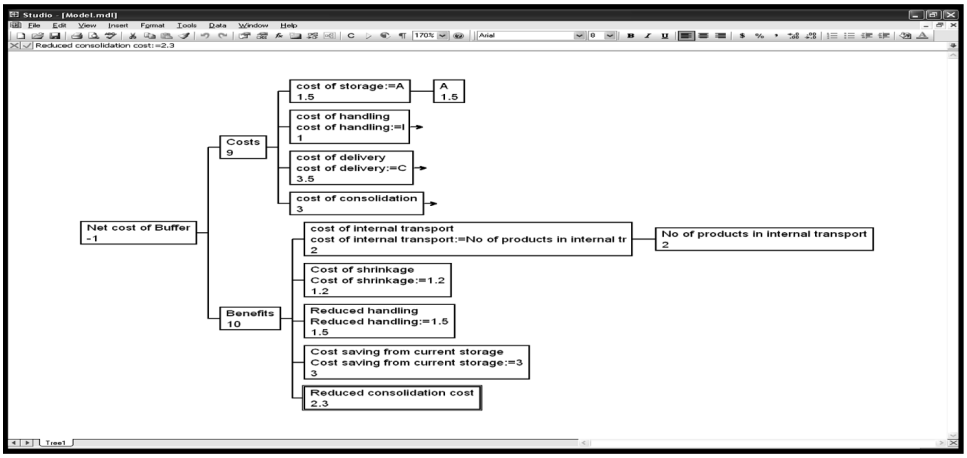
additional opportunity to explicitly select clearance outlets as the surplus stock would now be held centrally.

Figure 11 Difference between push and pull flow



To build a financial case to support this transformation, a cost evaluation was done for the proposed pull system and compared with the existing system. For this purpose, cost modelling was done using the Decision Pro software, the use of this helped in undertaking cost benefit analysis. A simple model was developed as shown in Figure 12. The investigation found that cost of having sufficient buffer would add more benefits and reduce the Excessive accumulation of stock effect. The analysis showed that the net cost of system (–1 in Figure 12) was less than the monetary savings owing to benefits that could be generated by establishing this system without even having to include the more complex sales volume and margin arguments described earlier. It was more likely that further cost savings would result from reduced stock accumulation in the supply chain. The analysis readily validated the adoption of Lean pull philosophy for supply.

Figure 12 Cost model – cost of buffer



The advantages, disadvantages and issues related to the proposed system are listed here:

Advantages	*Disadvantages*
• Reduction in internal costs of internal movement of stock	• Cost of consolidation in UK > cost overseas
• Stock supply against actual demand	• Chances of stock accumulation if not operated effectively
• Reduction in unsold stock/distraction from sales activities	• Increase in day to day logistics transactions
• Floor space area in outlets released for sales/profit opportunities	*Issues*
• Reduction in stock out, clearance markdown and conditions	• Geographical location
• Controlled flow of products	• Clearance strategy
• Planned drop times with no inward goods checking	
• Reduction in double stock handling	

4 Conclusions

The use of a Lean approach, and in particular an emphasis on identifying waste and its causes, was highly effective in quickly identifying a number of opportunities for improvement within the supply chain of the company. Once identified, the case for implementing beneficial change was made without necessarily having to quantify all the possible benefits of change. Successful change in one area of the operation facilitated and encouraged changes in others and the work is ongoing.

Key to the process was collecting the information needed for proactive decision-making to improve the decision-making process. A Lean supply chain process was proposed for the most problematic, long lead-time supplies to reduce and eliminate non-value-added activities in the supply chain flow. Overall, the research provided a theoretical and analytical framework that developed a process for reducing the costs associated with inventory, obsolescence, long lead times and distribution. Interestingly, the conclusion drawn required the provision of a UK-based buffer as better option than the highly wasteful stock accumulation in the company's outlets. With improved market intelligence refining procurement decisions, and a more responsive promotion and discounting strategy, it is more likely that the stock holding in the consolidation buffer could be reduced over time. However, it was clear to the research team that the provision of this consolidation centre was a key to de-cluttering the outlets and providing a stable base from which to make further operational improvements.

A Lean approach that can be adopted to address supply chain problems in the wholesale/retail sector is substantiated here but it also emerged from the study that a considered approach is needed with the response being tailored to the specific needs of the organisation. The supply chain is in many ways analogous to a production environment where long lead times require buffers to facilitate a customer-responsive environment. In this case, once the buffer was postulated with the associated potential to

use the demand pull to draw stock down then it became clear that there were critical timings in the downstream chain, which had been masked by the push-based system. In particular, the timing of promotion and discounting decisions could be seen to be crucial to retaining margins as was the proactive management of clearance policy to reduce cannibalism of potentially higher margin sales of new items by the presence of highly discounted and loss-making clearance stock within the outlets.

The research shows that Lean philosophies can be used to transform the existing strategies to address the problems related to inventory, obsolescence, long lead times and distribution in the supply chain. In addition, the authors have also highlighted the importance of accurate and appropriate information collection in the value/supply chain. Mining relevant data from the company database was one of the major tasks in the project and it was not surprising that decisions were not normally informed by this level of analysis. This obviously invites a re-examination of the management information system, which is designed for monitoring using aggregated data. However, it does not present product line analysis in sufficient depth to facilitate rapid and effective decision-making on profit critical decisions such as purchase volumes and pricing.

Overall, the research process identified and proposed improvements to the existing, systems using Lean principles to address process inefficiencies leading to excessive accumulation of stock in the supply chain, which are now being trialled. As well as addressing the primary issues, this analysis also highlighted a number of opportunities for further improvements in profit critical areas. The approach used was one of waste minimisation, which for a Lean supply chain process tries to reduce and eliminate non-value-added activities to the total supply chain flow. In this case, there was a balance to be struck by the introduction of an additional step in the process to reduce the higher costs associated with not having it there. Overall, the research provided a theoretical and analytical framework that facilitated a process for improving the decision-making culture and information collection. The successful adoption of Lean philosophies to this supply chain's problem of excessive accumulation of stock also validates the potential for cross-sector transfer of Lean approaches.

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