SUPPLY CHAIN RESTRUCTURING IN UK AEROSPACE

SUSAN B. GRANT, University of Portsmouth

In response to changing industry conditions, global economic challenges and national priorities in the last decade of the 20th century, the UK aerospace industry was seen to adopt a new model for business performance capturing affordability, better value products and faster delivery of products than in the past. However after a decade of lean implementation, encouraging evidence from numerous case studies indicate than while performance across aerospace organisations has improved, lean implementation has been narrowly applied and lacks a holistic approach to lean value. This is particularly prevalent in the development of lean supply chains. This paper, however, explores a case where supply chain restructuring has taken place resulting in the development of strong integrative relationships, enabled by e-commerce.

INTRODUCTION

As the body of literature embracing lean thinking has continued to grow (Oliver et al. 1993; Sohal and Egglestone 1994), a recent contender has included the UK Lean Aerospace Initiative. With its origins in the International Motor Vehicle program documented in the book *The Machine that Changed the World* (Womack et al. 1990), it comprises a Lean Enterprise Model (LEM) - a systematic framework for organising and disseminating research results that was developed by industrial members of the US aerospace industry in partnership with MIT. The LEM is operationalised by means of a comprehensive set of competitive practices supported by practice level metrics.

Lean Enterprise Model

PRINCIPLES
Responsiveness to change
Waste minimisation
Right thing at right place,
right time and in right quantity
Effective Relationships within the value stream
Continuous improvement
Optimal first delivered unit quantity
½

ENTERPRISE LEVEL METRICS
Flow time
Stakeholder satisfaction
Resource utilisation
Quantity yield
½
Overarching Practices (metrics)

Identify and optimise enterprise flow
(e.g., throughput)
Assure seamless information flow
(e.g., info retrieval time)
Optimise capability and utilisation of people
Make decisions at lowest possible level
Implement integrated product
and process development
Develop relationships based on
mutual trust and commitment
Continuously focus on the customer
Promote lean leadership at all levels
Maintain challenge of existing processes
Nurture a learning environment
Ensure process capability and maturation
Maximise stability in a
changing environment

The aim of the UK Lean Aerospace Initiative (a body composed of UK industrial sponsors, coordinated by the Society of British Aerospace Companies [SBAC]) has since its inception, been to raise awareness of 'lean production' philosophy throughout UK aerospace, and disseminate to the industry best practice methodology underpinned by 'lean enterprise' principles

The Marketing Management Journal
Volume 15, Issue 2, Pages 158- 164

and overarching practices (LEM) from a broad supply chain perspective. As such, the research agenda has, through survey and casework, sought to identify best practice and shed light on the 'hows' of progressing towards and achieving best practice across the supply chain.

Preliminary Survey - Supply Chain Integration

A preliminary survey conducted across 28 members of the SBAC, found supply chain integration initiatives were disproportionately fewer than internal change programmes undertaken over the past ten years. While many companies purported to have a high rate of success in developing relationships based on mutual trust and commitment between different supply tiers (one measure of supply chain integration), only 50 percent of survey respondents volunteered information, which indicated that actual alliances with direct suppliers ranged from as few as 0.5 percent of all suppliers to 100 percent. Where strategic alliances had been formed, the rationale behind formation mainly lay in the desire to access supplier expertise. Primes and first tier suppliers tended to establish a larger number of strategic alliances than lower tiers. Follow-up qualitative data revealed that where strategic alliances had formed, they fell mainly in the area of new product development. It is likely the long-term relationships are established for the duration of a product life cycle and the acquisition of a key competence is not available internally. Around 60 percent of respondents provided information on joint product development projects between suppliers and customers. Over half of these respondents, reported that customer/supplier involvement at an early stage of the new product development cycle was particularly strong in avionics, aircraft systems (hydraulic and electric), ground systems (radar, navigation and landing), weapons, and fixed wing. In many cases, the product was defined as being extremely complex and/or extremely complex new technology was being applied, and, in some cases, the product had a very long development time. New products in particular had strong cross functional/supplier - representation often with customers driving the development cycle.

Supplier integration was further measured by the existence of formal and non-formal communication programmes and customer access to supplier information, enabled by e-commerce. Many communication practices involved supplier conferences, road-shows, monthly/annual reviews, customer forums, and company visits, whereas more formal practices incorporated database communality between supply members, and use of IT systems (EDI) to ensure data trace-ability and availability, standardisation of software, and shop floor computerisation. The percentage of B2B transactions of direct product purchases was low.

Of the 82 percent of respondents providing information relating to customer access to supplier information, only a quarter of respondents regularly shared information on design specifications, product drawings and value added analysis. The majority were not proactive in sharing information with customers. From this pool of volunteers, the research then sought to identify examples of best practice in developing supply chain integration. An ongoing 'lean' initiative was identified. The selected case is an example of a model of integrated supplier-manufacturer involvement in metals service provision enabled by IT.

THE APOLLO-BAe SYSTEMS SUPPLY CHAIN

Under a climate of increasing competitive pressures, shrinking defence budgets and rising internal costs, BAe Systems military programs (assembler and manufacturer of military aircraft) began to consider significant and widespread changes to its manufacturing strategy. It had traditionally operated a manufacturing strategy fragmented across a number of sites, with duplication occurring at some facilities. BAe's decision to drive cost out of the whole manufacturing process and satisfy three fundamental needs of the organisation (to outsource most small detail manufacturing, further ration-

alise the supply base, and reduce mounting supply chain costs) led to a restructuring of the supply chain for metallic services.

BAe had traditionally purchased metal plate in bulk directly from a raw material supplier before it was passed off via off site stores to metal preparation/processing (billet preparation) lines prior to arriving at the factory for final NC machining. Purchase orders for metal plate extended for short periods only, and were in the main awarded on the basis of competitive bidding and capability, often resulting in a lower purchase price. While the role of the metal distributor to BAe in the 1990s had evolved to one where it would hold stock, part process materials, and deliver on a JIT basis to a number of key BAe sites, the relationships between suppliers and the OEM remained distant and wasteful. By 1998, BAe operated four distinct supply chains. Each of its four sites operated under four different materials management suppliers. Even though major changes had occurred in the way the OEM procured materials from its suppliers, resulting in cost savings from reduction of stock, space, work in progress and lead-time, further rationalisation of the supply base was sought in the shape of a transfer to a single service provider. The manufacturer was faced with outsourcing the entire physical handling of metallic materials.

Pre-Alliance

Apollo began life as a stock of blank aluminium slabs to UK and European markets. It pursued a strategy of competing through its service, i.e., JIT or line side-deliveries direct to the line, or through supplying a wider range of materials (commodities). Apollo increasingly adopted a value-adding distributor strategy. Its role expanded to include preparation of metal surface early in the 1980s. Lean initiatives moved upstream to the Apollo production process and direct delivery on a pull JIT basis of prepared metal to British Aerospace. Eventually Apollo took on integration of metal across all European metals suppliers and became Europe's largest independent distributor and processor of metals (Apollo stock aluminium, steel, titanium and nickel alloys in plate, bar, sheet and extrusion form) to the aerospace industry. It had, by the 1990s, around 70 percent of its business tied to aerospace. BAe's relationship with Apollo was essentially adversarial despite 15 years of association, with confrontation typically over planning issues and poor on time delivery performance. Apollo, however, was able to offer its customer a good price. Apollo's perception of the future with the Prime was short, that everything could change, and that there was no point in building for the future. Consequently, there was a very limited amount of investment into the relationship by both companies.

Supplier Selection

Apollo was selected as sole service provider on the basis of its ability to work to JIT delivery schedules and being one of the few suppliers with the capacity to service a large OEM such as BAe Military Aircraft and Aerostructures (BAe MA&A). In addition, it was considered an innovative company that had sought to maintain quality and add value to its original distributor role in the industry. Furthermore, Apollo had specialised skills in metal processing, and had acquired both the technology and focus in the area of metal processing. The savings to BAe would include releasing valuable floor space for core activities, reducing process costs, and enhancing performance improvement- throughput and working capital. By working closely with Apollo, BAe would simultaneously solve its cost problem in logistics (functionally divided, cumbersome and reactive) and the supply based problem in purchasing as well as transferring risk to another party. Apollo's weaknesses included a record of low stock turnover, high lead times, and poor on-time delivery. In 1998, Apollo signed up to a £500M, ten-year contract with BAe MA&A to handle materials supply to the Eurofighter, Hawk, Grippen and Airbus models.

Re-designing the Metallic Supply Chain – The Model

The objectives of the Millennium project were to transfer the supply chain from the OEM to that of a first tier single supplier. As such the structure of the supply chain would be simplified. Apollo Metals would take over small detail manufacture and small assembly previously owned by BAe, and in addition would be responsible for structuring and managing its relationships with lower tiers and BAe sub contractors. Apollo Logistics, the arm of Apollo Metals responsible for operating logistics services /physical handling of metals to four of BAe Systems key sites, was conceived.

The framework of the implementation plan was to:

- Create a new stock location site situated close to the manufacturing set-up, where materials would be managed on a kanban basis straight to the line, run by Apollo Logistics.
- Physically move all existing commodity from the OEM's stock location to a new warehouse run by Apollo Logistics. BAe wanted to transfer stock consisting of Aluminium plate, Bar, Tube, Soft/ hard sheets and castings and forgings.
- Create stock records at owner's site where material is booked onto the owner's site inventory records (Apollo Logistics)
- Transfer ownership of materials: material is issued off BAe Systems records (to allow invoice submission)
- Move supply chain: outstanding purchase orders are closed down and subsumed by Apollo group purchase orders.
- Ensure appropriate supply processes were in place. These included ensuring service level agreements were in place between Apollo and BAe, ensuring quality procedures were in place, and ensuring value based order for the commodity was in place between BAe Systems and Apollo Logistics, and that invoice processes were in place.
- Stock replenishment included planning-forecast in place and signed off by BAe Systems and Apollo Logistics; Purchasing activity and approvals were in place at commodity owner site and Business agreements were in place between BAe and the commodity vendors.
- Ensure that sub contractors were purchasing commodity through Apollo group.
- Ensure service level agreements and processes were in place for offsets.

Apollo Logistics was to be responsible for its own first level tier of suppliers (Tier 2). The lifecycle of the implementation took four stages and ran from February 1999 to early 2000.

Start–up Phase - February 1999- April 1999

The 'alliance' represented a big shift in behaviour on the part of BAe to treat its service provider as a close collaborator in their quest for cost savings. A key attitude/behavioural change included more open access to BAe's premises by the supplier. Information directly related to production schedules typically were now divulged to Apollo. Providing planning data to the supplier had the effect of reinforcing the importance of the supplier to the customer. BAe's implementation project manager adopted a consensus approach to 'development of the alliance' rather than dictating the approach to Apollo. There was also a dramatic change of style in the type of relationship that was now being advocated by Apollo, who took the view that it was important to start afresh, forget the past, and establish new types of business conduct. An atmosphere of mutual respect and recognition of each other's situation in the alliance was emerging with a focus on joint gains and a commitment to building strength into the future. Regular communication through progress reviews became fortnightly and were not just problem driven or for reviewing /sharing information but were also for reasons of relationship building. The difficulties faced in the start up phase of the project included overcoming initial

perceptions and entrenched attitudes on both sides of the teams and cynicism regarding the sheer scale of the task.

Development Phase
April 1999- November 1999

The development phase took eight months to complete. It included progress against the overall plan, establishing sub-project teams and resolving issues within the 30 sub-projects. Many practical items such as the physical movement of stock and the start up of the premises of Apollo Logistics were dealt with effectively during this phase. The Millennium project covered 16 products (e.g., castings and forgings, Brough tube, etc.) and a number of project areas that would need to be transferred before implementation would be complete. Each area threw up its own set of difficulties and progressed at different paces. The project areas included: Quality issues, Project management, Communications, Sub-contractors., The Warehouse Facility, Buy back reconciliation, Service level agreements, and IT infrastructure. The difficulties associated with the development phase included an effort to make Apollo Logistics into a tier 1 supplier before it was capable of operating to meet this requirement. There were difficulties with line problems and getting the project team to address them. Difficulties also began to emerge with the practical application of the buy back and pricing policy on the agreed contract.

IT Infrastructure

By January 2000, the Apollo Logistics infrastructure was in place and networked to a hub at Apollo HQ in Birmingham. Apollo and BAe had sought to integrate their IT systems and applications to meet this new challenge. Prior to Millennium, limited use of e-commerce was evident across the sector, however recent organizational extranet links between companies was set to enable immediate availability of live information, more effective scheduling, immediate electronic billing and invoicing. Technical data/base data (schedules) were to be quickly transmitted around the supply chain enabling reactive supply partners to respond. It was anticipated that material flow would flow faster along the chain, and that stock turns and lead times would fall. In addition, a great deal of transactional costs was removed as electronic information replaced paperwork. The investment in IT cost around 35-40 percent of total turnover overall, and was to form the basis to support future e-procurement.

Handover Phase
December 1999- May 2000

Early on in the handover phase, an executive review threw up a number of key issues. Apollo Logistics was not able to own all required functions, management information was not adequate, and the financial model being used was immature as was the balanced score card. Furthermore, roles and responsibilities within the alliance still needed to be established. The difficulties during this phase of implementation included no formal method of assessing when the right time to hand-over was to be, no method of monitoring or support mechanism was in place following the hand over of the supply chain to Apollo, and difficulties involving too many workarounds some of which could not be supported on an ongoing basis. By April 2000, 60 percent of the project was complete, 10 percent was ongoing and 30 percent had not yet started.

Completion Phase
May 2000- Near Future Date

The objectives within the final stage of implementation included the completed transfer of the supply chain to Apollo. This would include a completed buy and the effective hand over to line management by ensuring that all 'to be' processes were to be operated by the right businesses, i.e., Apollo Logistics and BAe Systems, both with all the enabling processes in place to support them. Among the difficulties was the perception by some that the process was finished, others perceived the implementation process was not fully integrated with the requirements of the executive review. Addition-

ally, some items were still not fully resolved, and some handed-over items were not working according to plan. An effective mechanism for escalating items is being sought.

COSTS AND BENEFITS

The restructuring costs to the supplier included a large capital investment in a new site at Preston, and investment in stock worth over £12M, in addition to funding a team of 15 people during project implementation. For BAe Systems the costs involved investments in IT, IT skills and team training. For BAe a relatively small but significant step change in process costs had occurred, as it was now able to control material price entering the metal supply chain and the industry's ability to supply at the right time. Through rationalising the supply base from four service providers to one, BAe was now able to control the supply through one place and at one point, driving down process cost. Prior to Millennium, inconsistent volumes, leading to shortages and inefficiencies, were common. The key benefits to Apollo enabled them to start identifying areas for added value, and to jointly develop a continuous improvement cost down culture, thus allowing them to differentiate themselves from the competition. With this changed relationship between customer and the supplier, Apollo's large stock base and its very low stock turns were transformed. Stock reduction, and the benefits of stock reduction, have become obtainable and are shared with the customer. This has come about partly through the implementation of an integrated logistics systems linking BAe's manufacturing and assembly operations, with metal service provision. The system enabled Apollo to respond to known demand instantaneously. Minimal stock was to be located at Apollo Logistics- a warehouse that delivered direct to the product line. Undoubtedly, this 'quick response' strategy designed to meet BAe's requirement in short time frames with minimal inventory is an example of the benefits of integrating IT systems.

SUMMARY

The preliminary case studies reveal that while lean thinking is infiltrating the strategic decisions of many UK aerospace companies, it is by and large the larger downstream organisations that are most active in embracing lean philosophy and implementing 'lean' programs. Despite this, and numerous examples where waste is being targeted and efficiency improvements are being reaped, the collective experiences of participants suggest a modest beginning and progress based on incremental changes and improvements mainly within the internal organisation. In so doing millions of pounds worth of waste in areas of the wider supply chain is being ignored. In particular, SBAC companies have to a greater degree neglected the important issue of supplier and customer integration in the areas of purchasing and logistics. Encouraging evidence however, from the Apollo-BAe Systems case illustrates the contribution of lean thinking to improved supply chain performance. This example demonstrates the development of a strong strategic alliance between a prime and first tier supplier, of which there is a highly co-operative management mode, distinguished by very open, communication and a high degree of information sharing. The degree of interest commonality (similar to Macneil's [1980] mutuality) is high and the relationship horizon appears long term. The introduction of lean practices in this case has required conviction, leadership and commitment from both sides. The difficulties persuading the workforce of the benefits of change have been evident in low levels of 'buy in' to the principles of lean supply management at other parts of BAe Systems and across European industries. With this in mind, picking the right people and programme managers to champion this initiative has been crucial and a key consideration in possible transferability of the model to other companies. Crucial to the implementation phase has been the effort to utilise a substantial team of individuals seconded out from line functions to develop the concept over an extended period. Once again picking the right people, and investing the time and training in them, has been cru-

cial to the success of the implementation. The substantial investment also in integrated systems and use of e-commerce has been necessary to enable seamless information flow and rapid transfer of information for both sides to mutually develop quality, delivery and service. Apollo Metals is now applying the lessons learnt from this experience as it seeks to transfer the model to a wide range of other industries including automotive, telecommunications and power generation.

CONCLUSIONS

The importance of organisational innovation in the aerospace sector arises from the need to remain competitive in face of a number of changes, namely accelerated globalisation, declining defense budgets and changing customer demands as technology moves forward. The global aerospace industry responded to these pressures by adopting a new model for business performance embracing lean philosophy as a route to doing so. The UK aerospace industry via the LAI has adopted similar principles, and in doing so has established a lean enterprise framework for quantifying performance across the entire supply chain. The first phase of the UK LAI research program centred on disseminating lean concepts and principles using metrics and case studies. This initial phase has highlighted areas of significant weaknesses in the industry's overall perception of the importance of supply chain integration as a competitive weapon. In particular, given the importance of supply chain integration in establishing systems efficiencies and competitive advantage (Macbeth 1994; Lamming 1993), and given the relatively poor levels of supply chain integration reported, it would seem imperative that later phases of the LAI programme address these weaknesses. It is hoped that the results of the study and on-going search for best practice examples will continue to contribute to the wider and long-term goal of providing a roadmap for companies to obtain a common understanding of lean principles and practices and the pursuit of supply chain excellence and competitiveness.

REFERENCES

Lamming, R. (1993), *Beyond Partnership Strategies for Innovation and Lean Supply.* Prentice-Hall International (UK)Ltd.

Macbeth, D. K. and N. Ferguson (1994), *Partnership Sourcing: An Integrated Supply Chain Approach*, London, Pitman

Macneil, I. R. (1980), *The New Social Contract: An Enquiry into Modern Contractual Relations*, New Haven CT, Yale University Press

Oliver N., R. Delridge, D. Jones and J. Lowe (1993), "World Class Manufacturing: Further Evidence of the Lean Production Debate", *Proceedings of the British Academy of Management Conference.*

Sohal, A. S. and A .Egglestone (1994), "Lean Production: Experience Among Australian Organisations", *International Journal of Operations and Production Management*, Vol. 14, No. 11 35-51

Womack J, D. T. Jones and D. Roos (1990), *The Machine that Changed the World*, New York, Harper-Collins.