Supply Chain Design at Jaguar: Bringing ‘Nirvana’ to Halewood

In 1998, with the decision to produce Jaguar’s new X-400, Ford’s Halewood plant had an opportunity to review the supply chain architecture-in terms of its suppliers, logistics partners, in-house body shop, assembly line layout and dealers- from a fresh perspective and to re-assemble these individual components in a way that would result in superior performance of the supply chain as a whole.

Ford’s Halewood plant was located in a sprawling 345-acre area near Liverpool, England and had come to be known as the ‘Home of the Escort’. Since 1963, over 5 million Escorts had been produced at Halewood. In 1992, Halewood received the Ford Q1 award for quality standards. In 1993, it became the first Ford plant in Europe to achieve ISO 9000 certification. However, by 1997 Halewood’s overall competitiveness, in terms of quality and productivity, had fallen below other Ford plants in Europe. At some stage in its long history the plant had lost its customer orientation, become very “number” focused and acquired a very bad reputation for employee relations. It had become difficult for the management to introduce and implement changes required for improving Halewood’s competitiveness, due partly to a lack of alignment of objectives across

1. For example, while the Saarlouis (Germany) plant of Ford had 104 repairs per thousand, Halewood had 400 repairs per thousand.

Jaguar had chosen to produce the new “Baby” Jaguars (known as the X-400) at Ford’s Halewood plant. This plant with an installed capacity of 250,000 cars per annum and a 3000-strong workforce skilled in high volume production, seemed very attractive to Jaguar from the location, logistics and cost perspectives, but had poor quality, productivity and labour relations. In order to ensure that producing the X-400 at Halewood did not negatively impact customer confidence in the Jaguar brand, Jaguar’s top management asked David Hudson, Operations Director – Jaguar Cars, to lead the transformation of the plant and to bring its performance up to the level of other Jaguar plants. In his 20-odd years of experience, Hudson had overseen successful plant transformation on two prior occasions - the transformation of Rover in the 80s and the transformation of Jaguar’s plants in the 90s when Ford took over Jaguar. The main issue facing Hudson was how to design the product, processes and supply chain architectures for Halewood that would enable Jaguar to launch and produce the new high-volume X-400s at high levels of quality, customer satisfaction and productivity, and to maintain the brand integrity of Jaguar.

Jaguar Cars Limited

Founded in 1922 in Blackpool, Lancashire, Jaguar Cars Limited is one of the most cherished and ambitious divisions of Ford Motor Company. Jaguar Cars produced the XJ, XK, S-type and Daimler range of luxury cars for the top end of the automotive market. Jaguar was one of the strongest brands in the automotive world with exceptionally high brand loyalty and a brand that evoked an image of a product with “sizzling” design and unmatched performance. With the new X-400, Jaguar was aiming to enter the lower range of the premium cars market, with higher production volumes and compete for the first time in a segment that had traditionally been a forte of Mercedes and BMW.

This case was written by Neeraj Kumar, Research Associate, under the supervision of Luk N. Van Wassenhove, the Henry Ford Chaired Professor of Manufacturing, at INSEAD. It is intended to be used as a basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation. Please also consult the companion case “Jaguar comes to Halewood: The Story of a Turnaround” (INSEAD case no: 03/2001-4938). Copyright © 2001, INSEAD, Fontainebleau, France.

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different levels in the organization, and also a somewhat adversarial relationship with the workers’ union. As a result, Ford’s top management had become wary of awarding new product lines to the Halewood Plant.

Jaguar considered various locations for building the X-400s, including sites in Germany and the USA, but chose Halewood due to Jaguar’s ‘British’ heritage and extensive experience of the workforce in high volume manufacturing, something that Jaguar needed for the new X-400. In addition, the Halewood press shop was already supplying body panels to Jaguar. Therefore, in November 1997, Jaguar signed a sourcing agreement with the Halewood unions that it would source the X-400 from Halewood on the condition that they implement Jaguar operating methods and processes and Jaguar quality and productivity standards before the launch of the X-400.

Nirvana

With the decision to produce Jaguar’s new X-400 at the plant, Halewood had an opportunity to review the supply chain architecture - in terms of its suppliers, logistics partners, in-house body shop, assembly line layout and dealers - from a fresh perspective and to re-assemble these individual components in a way that would result in superior performance of the supply chain as a whole. One of the cornerstone’s of Jaguar’s new supply chain strategy for Halewood was called “Nirvana”: to have just one person on Jaguar’s payroll managing the entire supply chain. The supply chain processes were modularized, precisely defined, their interfaces with other processes clearly outlined and the operation of these processes outsourced to a third party service provider with appropriate competence and experience in running such processes. Successful implementation of this concept required the design of product and processes that would allow Jaguar to plug-in third party service providers whenever an activity was not considered core to Jaguar’s business.

Product Design

Jaguar adopted Ford’s new product development process for the first time to compress the time to market for the new X-400. One of the key aspects of this process was ‘early supplier involvement’ and use of trusted full service suppliers with design and sub-systems integration capabilities. To facilitate Nirvana, Jaguar introduced a very high level of modularity in the design of the new X-400. Selected suppliers were made responsible for integrating whole sub-systems. As a result, there were only four suppliers for virtually all the X-400’s interior systems. One supplier, for example, would assemble the entire instrument panel and center console, including steering column and wheel, airbags and audio system and deliver it in a single piece to the Halewood plant, where the production operator would simply fix the whole panel in place with just four bolts. Halewood workers played a key role in preparing the new X-400 for production, helping to build error-proofing into the actual vehicle design.

Logistics

Jaguar set up a logistics vision for a lean supply chain at Halewood and wherever possible it pushed the concept of Nirvana. Right from the beginning, Jaguar decided to work with fewer suppliers for the new X-400. While the S-type Jaguars had 350 suppliers supplying different parts and sub-assemblies, the new X-400 would deal with only 130 suppliers. Most of the parts were sourced from suppliers within a 100-mile radius. Suppliers responsible for supplying large integrated sub-systems such as instrument panels, seats, etc. were required to locate their manufacturing or assembly facilities in an adjacent supplier park. Depending on the type of component or sub-assembly supplied by the supplier and the distance of the supplier from Halewood, the following approach was designed for achieving lean inbound supplies:

- The supply park - Deliveries based on a pull system with sequenced, line-side, just-in-time replenishment and 2 hours trackside inventory
- The UK Suppliers - Deliveries pulled by the requirements on the line on a real time basis; A single-shift point-of-fit with intelligent collection using a logistics partner; use of Jaguar-owned returnable stillages; payment on production and not on receipt of supplies
- European Suppliers: Deliveries on a daily basis to the point-of-need with the objective of maintaining two hour line-side inventory; supplies pooled within milk-round distance using a third party logistics partner and intelligent collection; rented returnable stillages.
- American and Rest Of World (ROW) Suppliers: Deliveries planned on a lead-time of 21 days, with each supply made on returnable stillages.

About 80% parts would be received with smart cards. Wherever possible, the supplier delivering to the Point-of-fit was made responsible for managing Halewood’s line-side inventory. As a result of this strategy, Tom Breen, Manager Planning and Logistics, projected that about 67% of the parts would be received line-side (with 65% of these sequenced as per the production schedule). All parts would have at least daily deliveries. There would be a maximum of three days supply in the parts warehouse and nil disposable cardboard packaging on the line-side.

2. Point of Fit: line side where parts were actually fitted on to the cars.
3. Point of Need (Market Places): centralized areas designed for material control where materials from suppliers were received within a specified time frame and stored before moving them to the line. The objective is to minimize traffic congestion within the plant and reduce lead time and cost.
4. These were parts data cards that would be used to control the flow of material between market places and all points of use in production avoiding any unnecessary material movements. These were similar to electronic Kanban cards.
External Logistics

The key feature of Jaguar’s new external logistics system for the Halewood plant was the ‘Intelligent Collection System’, i.e., collection of “exact requirements” on a shift basis from suppliers based in UK and on a daily basis from suppliers based in Europe and delivery to the plant within half-hour time windows.

Based on the forecast of orders and order line-up, a master schedule would be prepared and eight to 15 days of firm schedules issued. The logistics service provider would operate the release of firm schedules in the form of manifests to suppliers and plant and pick-up sheets to the truck driver. This manifest would serve as an authorization for the supplier to deliver parts to the driver. The driver would validate the shipment based on the manifest and would collect only the parts and quantities specified. The driver would refuse to collect excess material and would inform and seek advice from the logistics provider. He would follow the same practice in cases where a supplier shipped less material than required by the manifest. The driver would only pick up material in such cases on the approval of the logistics partner (See Figure 1). This was in addition to their existing practice of receiving advance shipping notices (via EDI) from vendors and electronic receipts.

On the outbound shipment of finished cars, Jaguar would take complete responsibility for delivering ‘the right cars at the right time’ to the dealers. The dealers would have complete access to see their orders during the build phase, and track them if necessary over the 15-16 day delivery lead-time. Jaguar would build cars to customer orders only.

Internal Logistics

Internal logistics at Halewood was another prime candidate for Nirvana. In the Escort days, there were about 95 workers employed in the internal logistics area within the assembly shop responsible for receiving materials, managing the warehouse, line-feeding etc. The workers involved in these activities were better paid than the production operators. The new process was designed such that no Jaguar employee would touch a part until it was fitted onto the car, or used in the assembly line. Empowering the driver in this manner gave Jaguar advance notice of short or excess supplies, which otherwise would only have come to their notice on the physical receipt of the shipment. As Breen put it:

“We would, for example, have six days advance notice in case of a shipment problem from a Spanish supplier. This would help us control a lot of instability in our supply chain and reduce a number of non-value-added activities related to chasing and expediting at the last minute.”

Facilities Design

In June 2000, just after the roll-out of the last Escort, totally new production lines were installed in body construction and trim and final area. Throughout the refurbishment planning and implementation process, Halewood personnel with their long experience of volume manufacturing, worked alongside Jaguar’s...
engineers to develop an optimum layout for all the new and revised facilities. The Halewood body shop was totally re-equipped to provide a state-of-the-art facility designed for ‘lean manufacturing’, incorporating the latest automation and diagnostic systems. All the robots were procured from a single manufacturer and had standardized controls so that any robot within the body shop could be replaced within an hour. The new layout was designed to ensure the most efficient flow of product through the body construction area. Virtually the entire installation was kept at floor level keeping in mind lean manufacturing objectives such as minimised walking distances within each work station, maximised ‘value-added’ work, and rigorous management of parts stocks at the line-side. In addition, to facilitate supervisors and team leaders to spot any quality or safety problems as soon as they occurred, line-side ‘Andon’ visible warning systems, were introduced.

The trim-line was redesigned from the old floor-level conveyor system to a new, three-rail overhead trim-line with the car held captive in a carrier. The overhead system was smoother and quieter than the old conveyor and allowed better access for the operators, apart from creating a more pleasant working environment. This system also improved visibility for easier ‘visual management’ of the whole area.

Process Design

When Jaguar took the decision to source the new X-400 from Halewood it had set the condition that Halewood would implement Jaguar operating methods, processes, quality and productivity standards. At the same time, one of the reasons for choosing Halewood was the experience of employees in high volume production. The key issue from a process design perspective was how to merge the knowledge and experience of high volume production among Halewood employees with Jaguar’s quality operating systems. Both elements were essential for the success of the X-400. There was also the issue of aligning Halewood’s underlying culture and values to those of Jaguar. Hudson developed a three-pronged implementation strategy to get Halewood through the Gateways.

The first prong of Hudson’s strategy was to make the organization quality and customer focused. The Halewood plant under Ford management had traditionally focused on cost as the top priority; productivity and quality were second and third priorities respectively. The priorities for Halewood under Jaguar management were quite the opposite: quality first, followed by productivity and cost. The emphasis of the two approaches was quite different. The new approach required operators to take up more responsibility for the quality of their own work and deal with any problems as soon as they were spotted. “Under this approach quality becomes everyone’s business,” explained Hudson, “not just the responsibility of inspectors at the end of the line.” While producing the Escort, Halewood workers were made to prepare Quality Process Sheets (QPS) to allow workgroups to document a standard for performing their tasks and to capture their experience of high volume production. At the same time, to increase understanding and appreciation of the Jaguar working processes, about 500 Halewood operators and supervisors were sent to Jaguar’s Castle Bromwich plant to work alongside Jaguar operators on the S-Type, which was in launch mode. These workers returned to transfer their knowledge to other Halewood workers.

The second prong of Hudson’s strategy was to implement lean manufacturing using a targeted approach called “Centers of Excellence” (CoE). During the last year of Escort production CoEs (consisting of small, show-case cells) were set up in different sections of the plant to serve as show-and-tell areas and to demonstrate lean manufacturing practices to the workers. “The CoE was a focused method of introducing all the best practices of lean manufacturing within a manageable area,” explained David Hudson. “Initiatives can be introduced, training done and then the people on the shop floor buy-in to the ideas and take ownership. So, the process becomes sustainable, and you can then move on and start in the next area.” Most of the well-known lean manufacturing practices were implemented in these areas and workers from other areas were invited to see them in practice. They could then go back to their own areas and set up their own CoE.

The third prong of the strategy was to transform Halewood’s culture from one of distrust, despair and disillusionment to one of mutual respect, positive attitude and trust. Hudson explained:

“First of all we had to develop a shared vision and get a whole-hearted commitment to this vision from everyone so that we could move forward in implementing these changes. Secondly, historically the problem with Halewood had been that after undergoing an improvement program they would quickly flip back to old ways. In order to make sure that the change this time around was a sustainable one, we had to take them through a culture change program and introduce changes in values and behaviours in the plant. We had to demonstrate commitment and resolve at the top management level and we had to communicate this again and again.”

Initial Success

What Jaguar had done at Halewood within the preceding two years was a first of its kind in the Ford-Jaguar world. During the last days of Escort production, some of the new processes were tested, yielding substantial improvements. As David Hudson said:

“We managed to reduce inventory in the last year alone by 50% on the Escort line. We also had about 50% improvement in the Escort quality and stood third in the JD Power ratings this year in the UK beating pretty fancy nameplates.”

In the press shop, labour productivity had gone up 26% over the past year.
As the February 2001 launch date approached, Jaguar was making sure that everything was in place. The post-
launch rise in production volume was expected to be steep. With a new product, supply chain architecture, new suppliers and the confidence of proven processes and experienced employees, Halewood was ready to deliver on the commitment made to Jaguar in November 1997.

Epilogue

Seven months into job one, it was not yet clear if Halewood had fully achieved what it had set out to do. While nothing had fundamentally gone wrong, there were still a number of issues to be resolved. Although the X-400 design team along with Halewood workers had put in a lot of effort in design for manufacturing, and error proofing, there were still a number of design changes required to eliminate manufacturability issues during mass production. By September 2001, in a period of five months, there had been about 8000 engineering changes and these were becoming a bottleneck. Another set of issues with product design originated in the lack of preparation on the part of suppliers in the supply park. Hudson confided, "When we made our sourcing decision what we hoped to buy was the corporate capability and what we actually got was a factory with a renowned name on it. Suppliers did not correctly anticipate the challenges of the new system and failed to put their best resources on the new site. Poor internal communication between the suppliers' design and manufacturing engineers often meant slow handling of design and quality problems."

Despite all the planning and preparations for the launch, managing the processes, ensuring that inventory objectives were met and coordinating information flows when the design of the product was still in a flux was quite difficult. Though the concept of Nirvana, the quasi-complete outsourcing of the logistics function, seemed to be working on the whole, there were some implementation problems due to lack of experience of the logistics provider in managing the internal logistics. In the initial days, the ‘intelligent’ collection system did not work as planned and there were instances of excess and short supply. As the driver, supplier and the logistics service provider gained experience the adherence to the procedure improved.

As planned, Point-of-Fit suppliers were responsible for managing their own line-side inventories. This change threw up some unexpected problems, as Tracy Chambers, the new Material Planning & Logistics Manager, explained, “The line-side suppliers had deputed their own representatives to monitor line stock. This worked well initially. If there was a problem with a part, the supplier representatives replaced them with good parts. However, this practice was actually hiding a lot of problems. As the volume picked up, these problems started to show up and caused some disruptions on the production line.”

While Halewood was still grappling with some of the teething problems, there were some encouraging signs. On the quality front for example, Halewood was setting new benchmarks in the Ford-Jaguar world. As Graham Miller, Plant Quality Manager said, “The warranty levels of the X-400 at launch, is better than the other Jaguar plants. Even in terms of labour hours spent at the dealer’s end to prepare the car for the customers, we are better than other Jaguar cars and comparable to the best in the industry. This is a clear indication of the fact that we are going in the right direction.” The concept of Jaguar quality systems had permeated the work force. Initial efforts that were put in to prepare the Quality Process Sheets (QPS) had come out to be very handy in standardizing the work procedures.

COMMENTS ON THE CASE STUDY

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The article on the new supply chain approach that Jaguar has set up so as to manufacture its new X400 in Ford's Halewood plant is interesting for more than one reason and raises a number of questions.

Jaguar's so-called “Nirvana” concept is a perfect illustration of a dream that many carmakers hold, one in which they have subcontracted everything, thus freeing themselves from any activity aside from that of a transaction principal. In this approach, carmakers offer their subcontractors facilities where said suppliers can assemble their own sub-assemblies and parts, right on the production line. The car itself is supposed to have already been designed in engineering departments that are external to the company, by means of specifications tender that details its functionalities as well as the customer expectations that the carmaker will be providing.

Of course, there are more or less advanced examples of this type of policy. Renault SA had this sort of organisation in mind back when it was running operations in the U.S., when it founded with Chrysler the ARCAD joint venture that was supposed to manufacture its “mini-Jeep”. Four or five first-tier suppliers were meant to be working directly on-site to screwdriver-assemble a car made of five modules. The lead supplier was to have total responsibility for quality, sourcing and funding.

To the best of our knowledge, Volvo has the record for maximum externalisation, achieving this by completely outsourcing a coupé vehicle to another Swedish company. The subcontractor was responsible for the vehicle from design to manufacturing, and was meant to deliver a ready-to-drive vehicle to Volvo. To reduce costs and delays, it engaged in as much cherry picking as possible, trying to assemble sub-assemblies that had already been developed and produced by other manufacturers. The quality of the assembly was never a problem seeing as the company had taken over Volvo's old Torslanda plant.
The main issues raised here are always the same:
- how far a carmaker go down this path?
- what is the minimum amount of control that a company has to maintain to continue to be considered a manufacturer?
- to be a manufacturer, does a company have to at least continue to build engines and/or chassis?
- should a company give up on this activity and operate solely as an assembler?

At one end of the scale, a company could have its vehicle entirely manufactured by a subcontractor located in a country offering competitive advantages like low labour costs or raw material prices, meaning that it would simply import the finished product and add the company logo to it before distribution to the end-user.

This kind of policy would suit the many distributors who already work in this way in markets such as audiovisual products or household appliances.

Impact on quality

One of the main issues this article raises is that of quality.

Quality control

What level of control is placed on the parts consumed during the vehicle’s manufacturing process?

As the supplier is responsible both for its own stocks alongside the line and for their assembly along the production line, it is both a party to this process as well as a judge thereof. It could be tempted for example to accept parts that do not comply with norms.

The article does not provide any indications as to the way in which visual or functional controls are being carried out. We have no data relating to Ppm (Parts per million) before and after the new concept’s implementation.

A 50% improvement in quality is the only thing mentioned. This improvement relates to the preceding vehicle and not to the new one.

It is ascertained in the days preceding the termination of the “Escort” manufacturing process instead of during the nominal production phase.

Management of quality disputes

How are disputes managed when quality problems arise?

In case of a product recall campaign, who would be responsible?
- the supplier of the part that is supposed to have been defective?
- the engineering department that designed and validated the part?
- the Jaguar Company, taking responsibility for the finished product?

Take the catalytic converter that turned out to be faulty. Who was responsible?
- the canner?
- the welder?
- the complete exhaust system supplier?
- and why shouldn’t the latter attribute the fault to the engine control provided by another supplier?

What is involved here is a transfer of responsibilities toward actors who are not meant to be exercising some of them.

In the Jaguar scheme, it is the logistical service provider’s truck driver who controls the coherency of the quantities of parts being returned. As such, this is the person who manages the extent to which items are too early or too late in terms of achieving targets. She accumulates both a driver’s and a production management technician’s competencies.

Is she capable of reacting to changes in output rates or in the product mix?

Production capacities

The Halewood plant had an existing production capacity of 250,000 vehicles a year.

What are production levels for the Jaguar X400? It would be interesting to see the answer to this question, since carmakers mostly tend to specialise their production sites. They have factories for their top-of-the-range products and others for mass production. How is it that a site that used to produce large quantities of a mid-range vehicle (around 1,000 vehicles a day) has been shifted to the production of a top-of-the-range vehicle with much lower output rates?

Managing modifications

With this sort of modus operandi, how can last-minute modifications by the engineering department be controlled?

8,000 modifications were recorded during the first five months after the new vehicle’s launch. This was a very high number that must have had a significant impact on quality levels, inventory, the obsolescence of parts and the management of modifications from a sourcing point of view.

Before... and afterwards...

To assess the progress that Jaguar has made, we still need some essential information about the preceding state of affairs.

No mention is made about how much time Jaguar takes to assemble a vehicle. Does the company meet the international standard of 60 vehicles/hour?

There is no info on stock levels, aside from a cut of 50%. What were the initial stocks?

What is the current quality of the parts received? Is it near 20 Ppm? What was it before?

Who is responsible now for the coherency of the needs that suppliers express?

Conclusions

Reading the document on Jaguar and its new programme, it is clear that they are still a long way away from Nirvana.

Nevertheless we should not forget that this approach does go in the same direction as the one that many other carmakers have been pursuing:
- an ongoing reduction in the number of suppliers
- a much more extensive policy of partnerships
- suppliers getting involved much further upstream in the programme
- suppliers acting as complete function integrators (cockpit, seats, etc.)
- suppliers located in “supplier parks” situated right next to the factory
- a subcontracting of services that up until that point had been restricted to people working directly for the carmaker
- a prioritisation of quality over costs
- suppliers being given access to the assembly line within the plant itself
- assembly operations on the plant’s line being directly carried out by the suppliers
- deliveries as close as possible to the point of consumption.

Carmaker policy has tended to involve their refocusing on their main business, whilst lightening their structures in order to enhance the flexibility of the tasks they deem capable of being delegated.

To achieve these aims, they rely on suppliers and service providers whom they ask to complete operations located downstream and upstream from their main activities; and sometimes to undertake work that no longer has anything to do with their core business.

This carmaker has to a large extent been opening itself up to the outside world, creating an extended enterprise in which all actors share risks and successes.

This has led to the advent of a policy marked by full integration and 100% subcontracting - but where does the truth lie in all of this?

There is no easy answer, seeing as the solution has to be adjusted on a case-by-case basis.

Currently the pendulum is swinging back and forth wildly, with significant shifts between the extremes. We do not doubt that with time it will calm down and repose itself quite naturally somewhere in the middle.