SUPPLY CHAIN RE-ENGINEERING: A CASE STUDY

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This article describes a fiasco that occurred and curative supply chain fix when a large assembler funded the set up of a new supply chain. Significant similarities exist between the concepts used in business process re-engineering and the case study. The article reviews stages undertaken to improve an inbound supply chain for complex plastic mouldings assemblies. The study was based on participant-observer and action oriented research styles. Confidentiality agreements have meant that all company names have been disguised.

INTRODUCTION

Large corporations have moved toward procuring significant proportions of the value added in their products. High volume manufacturing has focused on product configuration, assembly, test, packaging and despatch. These operations are reliant on predictable material supply.

Where the manufacturer produces various different products on relatively standard production lines, and demand is larger than existing capacity, products 'compete' to be made. Concurrent engineering teams in such circumstances must 'sell' their design to manufacturing. Typically, the key performance metrics used to assess the performance of manufacturing operations will assess efficiency, utilisation and downtime.

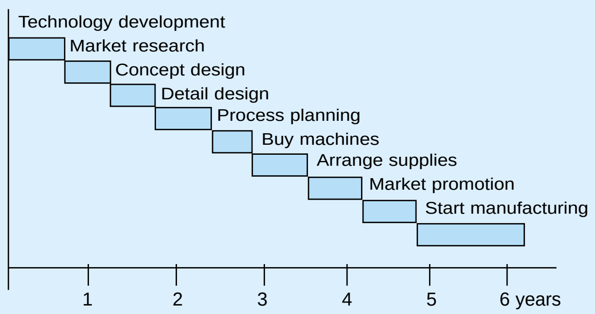
Traditionally, manufacturing management has had a vested interest in manufacturing long runs. Being reliant on suppliers for parts and sub-assemblies, manufacturing will want to establish that the processes and procedures used by suppliers are capable of achieving the quality, cost, quantity and delivery requirements. Interruptions to the inbound materials pipeline can cause manufacturing facilities to lay idle. If alternative products are available to manufacturing, it will make those in order to improve the operating efficiencies and make products to sell – that then pay the salaries and other corporate costs. If supplies of components are slower than expected, and deliveries start later, this can have significant affects on the profitability of the venture.

TRADITIONAL AND CONCURRENT ENGINEERING

Figure 1 [1] shows traditional design processes were sequential. Each departmental activity was completed and then passed on to the next department. If requirements did not change, and in markets where demand significantly was greater than supply, the total time to develop a product would not affect potential sales volumes.

Figure 1

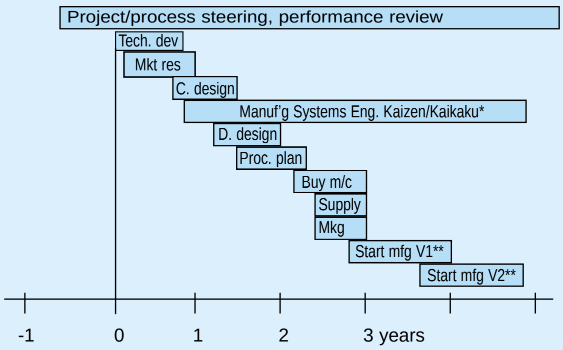
Traditional Product Development



The automotive industry is testament to the phenomenon that demand for variants increases as markets become saturated. Technology is being included in products to reduce their costs and to increase their functionality. To cope with both increasing product variety and the need to keep pace with changes in technology, corporations are having to reduce the time they need to develop products. In order to achieve this, concurrent engineering is being used.

Figure 2

Project Based Organisations Concurrent Engineering



* Kaizen - continuous incremental improvement
Kaikaku - radical improvement and development
** V1 and V2 - product release Version 1 and Version 2 .....

Figure 2 shows concurrent, or simultaneous engineering. Concurrent engineering requires all functions to be represented during the product creation process. This allows:

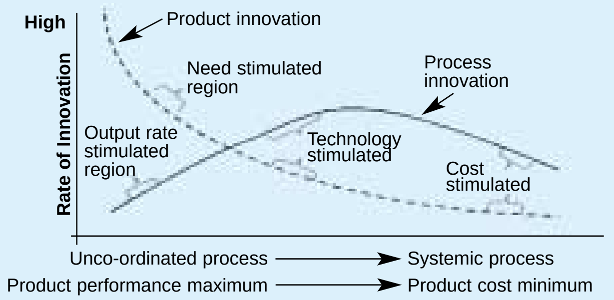
- Total product development lead times to be significantly reduced as a result of undertaking different aspects of the preparatory work at the same time. Management must learn to tolerate ambiguity during this process since many of the answers to key problems will not be finalised until near the end of the process. The design process is results driven, aided and supported by conceptual process models that do not hinder the creativity and vibrancy associated with new product creation processes. Traditional functional rivalries need to be put aside in order to work together to create and deliver goods required by the market.
- Marketing to prepare the marketing campaign to coincide with the new product ramp up and subsequent supply to the points of sale.
- Manufacturing to prepare plants. Manufacturing must plan the phasing out of an old product or the ramp down of production of the previous long run.
- Procurement to work with suppliers to develop verified supply chains that can produce to the quality, variety and quantity required. Suppliers must be responsive enough to produce component variants within a short lead time.

Project teams will take the output from a previous project, including the product design and the manufacturing processes that produced them, and develop variants from them. Hopefully, these will be improvements on the original.

Each new product ramp up is an opportunity for manufacturing to introduce significant and rapid changes (Kaikaku) to facilities. Typically these changes are associated with a re-engineering study that has also gone on simultaneously with the product design. Figure 3 [2] shows that for mature products like automobiles, the production process is unlikely to radically change. Indeed, the product may, and in most cases, should be designed to be made on existing production facilities in the existing process sequence. Instead, manufacturing is interested in ensuring that the product characteristics are optimised for quality – eliminating variations, and for ease of assembly. Continuous improvements (Kaizen) leads to significant changes occurring during the production life cycle of a product. Hence the process innovation line in Figure 3 does not have a high rate spike at its beginning, on the left-hand side. Since the product characteristics should already have been optimised, emphasis during the continuous improvement phase typically is on cost reduction to remain competitive against new products from competitors.

Figure 3

A Dynamic Model of Process and Product Innovation



RE-ENGINEERING

According to Hammer and Champy [3], re-engineering is an approach that can be used to produce radical improvements in performance. By radical, they suggested improvements by at least a factor of 10. The under-pinning principle of re-engineering is the blank page. Rather than trying to improve inherited processes, upon this page new business activities are designed according to how the company would invent its business today. Re-engineering focuses on process simplification and rapid product development using concurrent engineering. Re-engineering projects typically focus on:

- Process simplification – The elimination of hand-offs ensures prompt responses, clarifies responsibilities and forces the increases in both staff skills and process capabilities. Simplification can come from insights into the basic underpinning principles that are inherent in all repeated activities. The organisation needs to identify what they actually do rather than what they say they do. They then need to examine this principle and define processes that support these values.
- Implementation of new technology to automate routine activities.
- Training employees to undertake a wider range of tasks in order to add value in a reduced lead-time by eliminating hand-offs.

Champy [4] suggested that as much as 80% of all re-engineering activities did not realise results of the same magnitude anticipated prior to the start of the project. This can be a result of attempting to change the processes without changing the product that the processes produce. The Alpha Co. case study demonstrates that product simplification can facilitate process simplification.

Alpha Co.

An assembler, which we shall call Alpha Co., attempted to set up and then optimise a new supply chain in the United Kingdom. The principle sub-contractor is a moulding company, which we shall call Plastic Parts Ltd (PPL).

Alpha Co. is an assembler of high volume branded electronic consumer goods. Alpha Co. integrates technologies, defines products, designs finished goods, prototypes and assembles the core product. All accessories, packaging materials and component production are outsourced.

Alpha Co UK focused on designing bespoke products for Japan. To sell electronic goods in Japan is difficult due to the obsolescence risk associated with this market. The risk is created as a result of new product releases every six months. Goods launched at 40,000yen (about £200) sell at the point of sale for 5yen (about one half of a penny) after six to twelve months. These pressures created a requirement to ensure manufacturing supply chains operated effectively. This would reduce the obsolescence risk resulting from pipeline stock – components, work in progress and finished goods.

Plastic Parts Ltd.

Plastic Parts Ltd (PPL) and its supply chain were analysed with the aid of an interpretations matrix [ ] during a product verification production run for Alpha Co. Primary goals were to identify specific and generic lessons to learn for the design of logistics chains and evaluate the impact on profitability due to product designs requiring complex networks of suppliers.

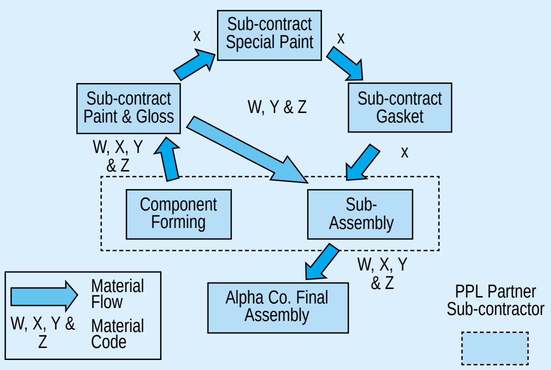
Plastic Parts Ltd (PPL) is a first tier mouldings company that is located in Sunderland. It is a British subsidiary of Nordic Plastic Parts (NPP). NPP advised Alpha Co. UK to make use of PPL during product design, tooling and production phases. This made geographical and cultural sense during design and tooling. From a purely logistical perspective, once tooling had been proven, NPP would have been a superior supplier due to proximity to the final assembly plant. It was agreed however that the supply chain PPL had newly established would be used since the planned production run was insignificant (0.375% of annual demand) compared to the volume of products destined for American, European and Asian markets.

Three sub-contract companies added value to components in the PPL supply chain – Gloss Paint Ltd, Special Coatings Ltd and Liquid Gaskets Ltd. Figure 4 depicts idealised component flows for the four components.

Conventional product designs required metallic radio frequency screening layers and gaskets to be applied to one side of part X. Hence, Special Paints Ltd and Liquid Gaskets were only required to add value to part X. Part Z was freighted from PPL directly to a distribution centre to be co-packed with the core product and accessories.

Figure 4

Planned PPL Inbound Aesthetic Component Chain



Originally it had been anticipated that materials would be pulled through the supply chain based on monthly demand forecasts and weekly delivery requirements. In theory, PPL sold moulded parts to the painter. They painted the parts and scrapped a percentage due to their process yield. The painter sold on the remainder either back to PPL or on to Special Paints for metallic coating. Special Paints would add their value then sell the parts on to Liquid Gaskets. It was expected that the suppliers would order, from the next lower tier supplier, the volumes required by the next company in the chain plus their anticipated or actual yield rate loss.

Difficulties associated with the scenarios became apparent during ramp-up. Preparations during the product design and tooling phases had set up unanticipated scenarios. None of the companies in this scenario anticipated Forrester effects or quality defect liability issues. The complexity created by the liability/ownership policy and erratic yields created a lack of production synchronisation that resulted in Alpha Co. purchasing involvement on a daily basis to expedite parts between moulding and the factory. This was done on an adhoc basis by telephone and weekly visits. Other key issues identified were a lack of co-ordination between the independent companies, low process yields and missing batches of parts. Feedback on the expectations of quality began to be received from the distribution centre that robotic painting had too many imperfections. Gloss Paint Ltd had a lack of employees that were skilled to the required level. The managing director of Gloss Paint insisted on working shifts in the hand-finishing booth to achieve the yield and volumes required.

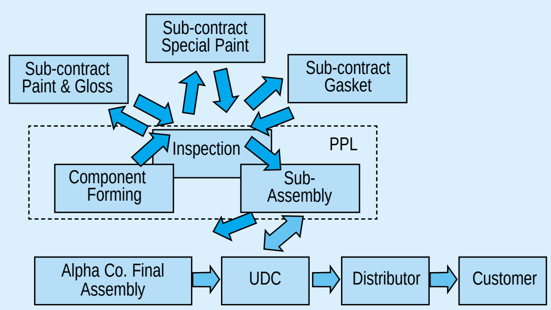
The yield rates from processes undertaken by selling companies required that the seller inspect the components before despatch. Suppliers in the component X supply chain route rapidly came to the conclusion that they would not accept the risk of buying the parts, adding their value and then not being able to sell the parts due to defects that had been present prior to delivery to themselves. This situation stalled ramp-up. At the lessons to learn meeting during the ultimate week of production, Alpha Co. sourcing reported that, for every 15,000 parts Plastic Parts Ltd moulded, they received back from the sub-contractors for sub-assembly on average 3000. This in effect was a profitable business for Plastic Parts moulding operations since the cost of purchasing, adding value and scrapping fell to the other sub-contractors.

The route problem was the trading arrangements between each successive pair of companies. At an inter-business level, a commercial philosophy of 'you are responsible for your own work' contributed to the creation of the scenario where the subcontractors would not accept costs of inspecting lower tier supplier's components at their premises.

Component X became the bottleneck holding up production at Alpha Co. An intermediate solution was devised that relied on Plastic Parts inspecting the components after each supplier had added its value, shown in Figure 5. Plastic Parts had to act as guarantor for the receiving contractor that the inbound components were of the appropriate quality. Any defects then created would be, at least in theory, the responsibility of the receiving contractor as a result of damage during its value

Figure 5

Intermediate Solution: Inspection Scramble



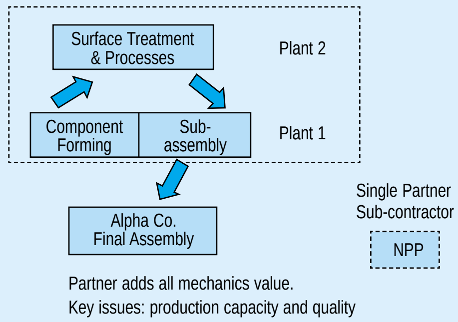
Issues: Yield, lead-time, quality, ownership, control, transport, product damage, pointing the finger, delivered quantities .....

adding operations. The main contractor returned damaged or otherwise rejected parts to the previous contractor for credit note purposes. Plastic Parts was then in a position to determine the amount of money owed to each company. This solution allowed the inbound logistics chain to supply the assembly plant with at least some of the part sets required.

This situation lead to restricted production volumes as a result of repetitive, and consequently inefficient quality inspection procedures, and insufficient administrative control systems to track batches of components. Gross volumes of the product were planned to be in excess of three hundred thousand units. During the production run, less than ninety-one thousand units were produced due to inadequate supply, damaged parts, and late delivery. To avoid this occurring on higher volume product runs for other regions, generic design changes were recommended and implemented based on the use of alternative technology solutions that allowed for a simplified supply chain to be developed, shown in Figure 6.

Figure 6

Revised Inbound Mechanics Value Chain after Supplier Development



Advantages: Better information flow, better quality planning, supplier accountability, better production planning.....

It was decided that capabilities would be created in Nordic Plastic Parts for processes not currently performed by them. This increased Nordic's percentage of the value-added processes and avoided diffusing their responsibilities to other contractors. This strategy aimed to simplify batch tracking and clearly assign accountability.

CONCLUSIONS

Over the course of the sales window, the delayed ramp-up and the inability to deliver sufficient volume of acceptable component sets reduced the total number of products produced by more than 69.8%. This created a net financial loss for both production and the product creation programme. The relationship with the principle downstream business customer was also negatively affected as a result of failing to deliver almost any batches on time.

Issues identified resulting from the lessons to learn study led to recommendations to resource aesthetic component sets to Nordic Plastic Parts and its competitors, and re-engineer the supply chain. This required:

1) the elimination of 'hand-offs' from one company to another to ensure responsibility and accountability for order fulfilment, and

2) the elimination of special radio screening paints by adopting alternate hard state electronic screening.

Nordic Plastic Parts was selected to supply components for a higher volume product. Nordic had facilities capable of European standard painting. Alpha Co. elected to assist Nordic in creating capacity in various surface treatment processes that had previously been subcontracted. This constituted a supplier development project.

It was later learned that Plastic Parts Ltd had become a contractor to one of Alpha Co.'s direct competitors. It is understood that this relationship made use only of Plastic Parts, producing aesthetic finishes by in-mould decoration and multishot moulding techniques that used more than one polymer colour to produce parts for European markets.

Lead projects in concurrent engineering environments must ensure that the supply chain issues are taken into account early in the project. It is vital to reduce the number of suppliers in any chain. Clever designs should be used to reduce the number of process steps required. If it is necessary to have multiple processes, and if volumes are sufficient to merit the investment, a single supplier should be nominated as the turnkey producer. They should be capable of adding all, or most of the value to the materials.

The two most important lessons learned were to avoid circular supply chains and to avoid 'purchase-add value-sell' type supplier networks. While it is detrimental to the manufacturing corporation that commissioned the products, it is good business for the supplier that starts and finishes the supply chain. They can make a profit from their initial sales to their supply chain customer. This is a result of the yield losses in the chain of sub-contractors. This situation limits the turnkey supplier's motivation to assist the other suppliers to improve their stock monitoring and improve their production processes. 'Purchase-add value-sell' supplier networks focus on transactions rather than on flow of goods through the whole supply chain. It is necessary for the large assembler to guarantee profit per product in exchange for co-operation on improving quality, tracking batches and reducing costs. Minimising the number of suppliers involved increases purchasing function's concentration on those important relationships.

Principles found in business process re-engineering have to be applied to supply chains in order to ensure that the best solution is found prior to launch. Inherent assumptions such as the 'purchase-add value-sell' should be challenged, and solutions found to suit the particular product and production scenario.

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