Implementation of Milk Run Logistics System in an 
Auto Component Manufacturing Plant

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Abstract

In today’s competitive business environment, automobile companies worldwide are shifting their attention towards understanding and implementing extensive supply chain management principles that integrate the product, process and information flow within and across organizational boundaries. Managing supply chain risks have increased dramatically as companies operate in long-reach systems across international boundaries whilst simultaneously seeking to reduce costs. In recent years supply chains have mainly focused on the outbound operations, being the customer-oriented part of the business, whereas the control of the inbound operations was generally left to the suppliers. But now having the outbound operations streamlined and extracting additional benefits has become more difficult. Taking greater control of inbound logistics is becoming a top priority for many manufacturers today. Turning attention to inbound logistics will not only reduce costs, but also generate more collaborative relationship with internal organizations, suppliers and logistic providers, which will ultimately result in a more effective business process from which all parties will benefit.

In the current work, issues in the inventory management of a first-tier automotive manufacturing plant were studied. Using value stream mapping, the current supplier lead times, order cycles, buffer and safety stocks for various supply chain players were studied. An appropriate milk run logistics system was designed and implemented in the inbound operations area to reduce the high inventories and optimize transportation cost. Certain standard operating procedures were designed to make the system successful in the long run.

Results from this implementation of milk run system showed a significant improvement in inventory reduction, reduced transportation cost and other intangible benefits. Benefits proved to be on win-win basis for suppliers and the manufacturer. Based on the results obtained, few recommendations have made to improve other areas where there is ample scope for improvement.

Key Words: Supply chain management, Milk run logistics, Inventory reduction

Abbreviations

PC&L Production Control & Logistics 
OEM Original Equipment Manufacturer 
IDS Intermediate Drive Shaft 
GRN Goods Received Note 
NRGP Non Returnable Gate Pass 
SOP Standard Operating Procedure 
ERP Enterprise Resource Planning

1. Introduction

Supply chain management is a broadened focus that considers the combined effort of all the companies involved in the manufacturing of goods and services, from suppliers to manufacturers to wholesalers to retailers to final consumers and beyond disposal and recycling. It encompasses everything required to satisfy customers and includes determining which products they will buy, how to produce them, and how to deliver them. The supply chain philosophy ensures that customers receive the right products at the right time at an acceptable price and at the desired location.

The primary purpose in establishing supply chains is to minimize the flow of raw materials and finished products at every point in the pipeline in order to improve productivity and achieve cost savings. Companies today must be fast and flexible enough to react quickly to changes in customer demand and do it with little inventory. Too much inventory is a certain indicator of more serious and costly business process and systems problems that can be rooted very deeply across the organization. These may include poor forecasting, inadequate order/product specifications, ineffective production scheduling, poor quality, bottlenecks, long cycle times and Production process problems.

The objective of this paper is to reduce inventories in the inbound operations of a first-tier auto component manufacturing plant by adopting milk run system.

1.2 PROBLEM BACKGROUND

The work reported in this paper was based on a case study carried out at Delphi Automotive Systems Pvt Ltd (Plant 81), Bangalore which is a wholly owned first-tier subsidiary plant of Delphi Saginaw Steering Systems based in USA. Delphi's major products are half-shafts, columns, intermediate drive shafts and steering pumps. It supplies these products to all the major OEM companies in India and few other OEMs abroad.

It has huge supplier base which includes the local suppliers (Bangalore based, Chennai based and north based) in India and many other suppliers abroad. All the suppliers are quality certified and technically competent. Today the plant produces 2600 half-shafts and 1400 columns a day in two shifts. PC & L department controls the planning of raw material, production planning, packaging and customer support. PC&L department has one of the important functions of Delphi in meeting customer demands. The responsibilities of PC&L are planning and ordering of raw materials, production planning, stores, receiving, co-ordination with logistics, packaging, dispatch and customer support.

From the past few months PC&L personnel were facing problems with excess inventory in the super markets which is consuming lot of storage space as shown in Figure.1. The issues in the inbound operations are

- Excess inventory
- High transportation cost
- Much of traffic at dispatch area
- No control over supplier arrival times

Figure 1 Excess inventories in stores

In order to overcome all the above mentioned issues, the PC&L department had initiated a brainstorming session, which came up with a suggestion that implementing a milk run system in the inbound operations area would answer all the issues. An elite cross functional team was formed to carry out the Project.

1.3 EXISTING MATERIAL FLOW

The company follows cellular manufacturing concept, where in similar type of machines are grouped in different cells. All the
four products produced in this plant are routed through several machining operations, sub-assemblies and then assembled at the final assembly section. All the material that is transformed in to final products comes in the form of raw, semi-finished and finished material from suppliers. For half-shaft and IDS group, the raw material is routed through heat treatment, machining, sub and final assembling. Where the material for column and pumps comes in the form of semi-finished and finished form processed through machining, sub and final assemblies as shown in the Figure2. The final assemblies are packed as per customer standards and moved to stores for dispatch.

![Diagram](image)

**Figure 2 Material flow of all products**

Value Stream Mapping is a tool used to analyze the processes or activities in a manufacturing operation. In this case, a value stream map at the macro-level has been generated to understand current material flow, information flow and procurement lead times for various suppliers and delivery lead times for customers.

**2 DESIGNING MILK RUN SYSTEM**

Among the four product groups, the half-shaft and column groups were selected for milk run system due to their high volume production. After studying the literature on industry best practices in the logistics systems, we came up with an outline of implementation plan for the milk run system. The implementation steps decided are as follows:

- Supplier selection
- Data collection
- Decide conveyance frequency for each supplier
- Standardize bins and determine lot size and pack size
- Determine floor area required for each supplier and define truck routes
- Visit supplier for understanding and trial runs
- Break up cost into component cost and logistics cost
- Amend purchase orders for the parts
- Select the transport service provider and release contract
- Training to the suppliers and transporter
- Trial runs and implementation

**2.1 Supplier Selection**

To begin the milk run system, Bangalore based local suppliers were considered. Among them, the suppliers with high volumes were identified as potential suppliers. Quality, delivery and window performances of these potential suppliers were studied for the last one year period. Based on the study, two suppliers for half-shaft and three suppliers for column group were finalized to start the milk run system.

**2.2 Daily Volume requirement**

After finalizing the suppliers, all their part number details and bin sizes were collected from the stores area. Using ABC analysis, all the items chosen for milk run system were classified into A, B, C groups and pick-up patterns for each part number were decided based on the demand. Three different pick-up patterns such as daily, twice in a week and weekly were designed to collect these parts. Average daily requirement for the chosen parts was calculated based on the last one year customer pull and next six month sales forecast.

These average daily requirements of parts were determined based on the current production of 1400 column units and 2600 units of half-shafts per day. The designed milk run system is capable of delivering parts up to 25% increase in the current production volumes. And these average daily requirements have to be reviewed at least once in six months.

**2.3 Route and Vehicle Selection**

Based on the average daily requirement and pick-up patterns, standard bin sizes were determined for all the parts included in the milk run system. Supplier-wise floor area requirement was determined by simulating bin sizes in AUTOCAD based on the pick-up patterns. Two different milk run routes were planned to collect material from the five different suppliers as shown in Figure3. Industry standard vehicles considered and vehicle utilization calculated with help of AUTOCAD software. Two different vehicles were finalized for the two milk run routes.

![Diagram](image)

**Figure 3 Existing and Proposed systems**
1) Material is issued to line side from stores as per requirement.
2) Planner gives schedule to suppliers every Thursday by e-mail.
3) Planner gives the schedule and hard copy of check sheet to transporter every Monday.
4) In a day cycle, transporter loads all empty bins to the vehicle and leaves Delphi.
5) Supplier unloads empty bins, loads shipment and records in the check sheet.
6) Transporter reaches Delphi from the supplier after collecting all the material.
7) Receiving area verifies the material and issues acknowledgement to the transporter.
8) Receiving area prepares GRN (goods received note) and sends a copy to the suppliers.
9) Receiving area forwards GRN to the accounts department for payment release.

3 IMPLEMENTATION

After designing the milk run system, the purchase team had negotiated the logistics cost reduction from the component standard cost with the suppliers. Among the four suppliers for two milk run routes, the route 1 suppliers agreed to logistics cost reduction from the standard price where the price reductions with the route 2 suppliers are yet to be finalized. Milk run route 1 has been implemented with immediate effect. After the reduction was obtained the purchase orders for all the parts in the milk run system route 1 were modified with the new standard cost. The team also identified a transport service provider for the milk run system. The transporter had been trained in the milk run system with several trials. All the suppliers were informed about the milk run implementation start date. The first two weeks of the implementation plan were pilot trial runs, in which one of the team members accompanied the vehicle to make sure that all the standard procedures were followed and to get the feedback from the suppliers.

3.1 Transporter Check Sheet

The following sub-sections briefly explain the standard formats designed to make the milk run system flaw less and make it successful in the long run. In the milk run system, Delphi, suppliers and transporter are the three participants. There is a need for one document which connects all three of them with material and information flow. A transporter check sheet is prepared to eliminate confusion and misconceptions between the participants. This check sheet will be recorded by all participants and will be documented in transporter’s possession. The documentation procedure is as follows.

1) Planner issues check sheet to transporter for that week. Different sheets will be given for different suppliers.
2) Transporter loads empty bins in the vehicle and collects NRPG from receiving. The Receiving personnel record departure time in the check sheet.
3) The Supplier will unload the number of empty bins and print in the check sheet.
4) The Transporter will verify the number of bins and quantity of each part numbers and record in the grey shaded columns.
5) The Supplier will record any material shortage or any other comments regarding that day’s shipment in the supplier remarks column.
6) The Supplier will hand over the in-voice documents and inspection reports to the transporter, which in turn will verify them to make sure that all the documents are there. The transporter and supplier will sign in the check sheet.
7) At Delphi receiving area, the receiving personnel will
Verify the material in terms of quantity and bins before transporter unloads the material. The Receiving personnel will record any material shortages or any dirty, damaged bins in the remarks column.

8) After verifying all the in/voice and inspection reports the receiving personnel will put seal and signature in the check-sheet and with that the transporter's transaction will be completed and the check-sheet will be retained by the transporter for documentation.

3.2 Line Stoppages Recording Form

Production line stoppages are the major issues that strike the company's policy and strategy in meeting customer demands. Line stoppages can occur due to several reasons like machine break down, material shortage, man power shortage, etc. The most common reason for production line stoppage is material shortage or no material. These line stoppages have great impact on the complete supply chain. For example, if there is one part which is not available to assembly line at tier 1 suppliers, they have to change the running model production and reschedule the build plan, which triggers immediate demand for some other parts impacting some other tier 2 suppliers.

To overcome all these issues, an appropriate line stoppages recording format has been designed in Microsoft Excel software to record production loss for the total month. This sheet is applicable not only for the milk run parts but also for any part number and any supplier. This sheet is designed based on the Pareto principle. It has been implemented in the columns production area and a sample format recorded at the end of July is presented in below Figure 8.

<table>
<thead>
<tr>
<th>Parts</th>
<th>Value in mm</th>
<th>Contribution</th>
<th>Overall</th>
<th>Cumulative</th>
</tr>
</thead>
<tbody>
<tr>
<td>26121071</td>
<td>1200</td>
<td>48.2%</td>
<td>48</td>
<td>48</td>
</tr>
<tr>
<td>26112853</td>
<td>480</td>
<td>19.3%</td>
<td>19</td>
<td>67</td>
</tr>
<tr>
<td>26111744</td>
<td>450</td>
<td>18.1%</td>
<td>18</td>
<td>86</td>
</tr>
<tr>
<td>26109694</td>
<td>300</td>
<td>12.0%</td>
<td>12</td>
<td>88</td>
</tr>
<tr>
<td>26109688</td>
<td>30</td>
<td>1.2%</td>
<td>1</td>
<td>89</td>
</tr>
<tr>
<td>26124750</td>
<td>20</td>
<td>0.8%</td>
<td>1</td>
<td>90</td>
</tr>
<tr>
<td>26110896</td>
<td>10</td>
<td>0.4%</td>
<td>0.4</td>
<td>90</td>
</tr>
</tbody>
</table>

Total production loss 2490

Figure 7 Sample transporter check sheet

Figure 8. Line stoppage recording form

Table 1 Countermeasure for line stoppages

<table>
<thead>
<tr>
<th>S.No</th>
<th>Problem Description</th>
<th>Total Column Loss (No's)</th>
<th>Countermeasure</th>
<th>Responsibility</th>
<th>Target Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Production loss for 1200 minutes due to Shaft Tubular YV not available and Quality Issue</td>
<td>364</td>
<td>Five why analysis requested from supplier</td>
<td>Supplier</td>
<td>8-Aug-07</td>
</tr>
<tr>
<td>2</td>
<td>Production loss for 480 minutes due to YH Tubular not available</td>
<td>1584</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Production loss of 450 minutes due to Bracket Assy Pivot Lower Quality Problem</td>
<td>1485</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Production loss for 300 minutes due to YN Upper Stg. Shaft not available</td>
<td>990</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Production loss for 30 minutes due to Jacket Upper Stg. Quality Problem</td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Production loss for 10 minutes due to YV Upper Stg. Shaft due to Quality Problem</td>
<td>33</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.3 Responsibility charts

In order to make this milk run system successful in the long run, there are certain responsibilities that all the three participants (Delphi, Suppliers and Transporter) must follow. Different standard operating procedure (SOP) sheets are designed for all three participants along with milk run flow process.

4 RESULTS AND DISCUSSIONS

Implementation of the milk run system had substantially reduced excess inventories in the stores, transportation cost and inventory carrying cost. To compare the results, the inventory data was collected from company's ERP system and measured against the actual sales numbers, an average inventory level maintained at the end of every month was then arrived. The following figure. And table numbers explain the inventory reduction due to milk run implementation. The inventory reductions after implementing the milk run system are shown in below figure.9 were achieved. All the milk run route 1 results discussed in the following sections are to be considered as achieved results or in the process of achieving. All the milk run route 2 results are to be considered as projected results as the cost reduction from route 2 suppliers is yet to be obtained and implemented.

Table 2 Transportation cost savings

<table>
<thead>
<tr>
<th></th>
<th>Route 1</th>
<th>Route 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before milk run</td>
<td>Rs. 304/day</td>
<td>Rs. 1024/day</td>
</tr>
<tr>
<td>After milk run</td>
<td>Rs. 1200/day</td>
<td>Rs. 1024/day</td>
</tr>
<tr>
<td>Savings/day</td>
<td>Rs. 1056/day</td>
<td>Rs. 1024/day</td>
</tr>
<tr>
<td>Savings/year</td>
<td>Rs. 6,03,320</td>
<td>Rs. 1,94,700</td>
</tr>
<tr>
<td>Total savings</td>
<td>Rs. 7,96,021/year</td>
<td></td>
</tr>
</tbody>
</table>

Figure 9(a,b,c) Achieved inventory reduction results

Figure 10(a, b) Projected inventory reductions

High inventories before milk run
Figure 11 Reduced inventories in stores

The high inventory levels hold a huge amount of capital - known as tied up capital. It is a kind of opportunity cost, as it cannot be used in the circulation and creates new values for the owners. It includes the standard price of the inventory quantity, building rent, handling cost, insurance and taxes. In this case, the tied up capital is considered as standard price of the inventory quantity alone. It is a one-time saving for the company, the amount capital which would be released after implementing milk run is listed below in the Table 3.

Table 3 Release of tied up capitals

<table>
<thead>
<tr>
<th>Tied up capital in Rupees</th>
<th>Route 1</th>
<th>Column Parts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before milk run</td>
<td>After milk run</td>
<td>Before milk run</td>
</tr>
<tr>
<td>Rs. 25,27,845</td>
<td>Rs. 8,52,209</td>
<td>Rs. 35,20,546</td>
</tr>
<tr>
<td>Route 2</td>
<td>Half shaft parts</td>
<td></td>
</tr>
<tr>
<td>Before milk run</td>
<td>After milk run</td>
<td>Before milk run</td>
</tr>
<tr>
<td>Rs. 20,10,512</td>
<td>Rs. 10,17,322</td>
<td>Rs. 12,87,811</td>
</tr>
</tbody>
</table>

5. CONCLUSIONS

Integration of the supply chain has been a powerful and compelling enabler across a wide range of industries in the past. As a result, many of the core supply chain concepts and principles have been put into practice in a much more effective way. Information sharing, multi-party collaboration, outsourcing and partnerships are the driving factors in achieving competitive advantage over the other supply chains. The current work proved that, an organization must focus on inbound operations as much as on outbound operations and customers. Eliminating the waste in the inbound operations improves the value of the supply chain which in turn delights customer and helps organizations in moving towards their vision and goals.

- The proposed milk run implementation approach described in this paper can be applied to other areas of the plant to achieve significant cost benefits and other intangible benefits.

Table 4 Summary of results

<table>
<thead>
<tr>
<th>Tangible Benefits</th>
<th>Route</th>
<th>Before milk run</th>
<th>After milk run</th>
<th>Projected</th>
<th>Achieved so far</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventory reduction</td>
<td>Route 1</td>
<td>2-54 days</td>
<td>2-8 days</td>
<td>2-32 days</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route 2</td>
<td>2-5-19 days</td>
<td>2-4 days</td>
<td>2-32 days</td>
<td></td>
</tr>
<tr>
<td>Release tied up capital</td>
<td>Route 1</td>
<td>Rs 25,27,845</td>
<td>Rs 8,52,209</td>
<td>Rs 10,76,997</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route 2</td>
<td>Rs 20,10,512</td>
<td>Rs 10,17,822</td>
<td>Rs 12,87,811</td>
<td></td>
</tr>
<tr>
<td>Transportation cost savings</td>
<td>Route 1</td>
<td>Rs 33,14/day</td>
<td>Rs 12,00/day</td>
<td>Rs 12,00/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route 2</td>
<td>Rs 82,84/day</td>
<td>Rs 12,00/day</td>
<td>Rs 12,00/day</td>
<td></td>
</tr>
<tr>
<td>Inventory carrying cost savings</td>
<td>Route 1</td>
<td>Rs 2,01,051/year</td>
<td>Rs 1,01,732/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route 2</td>
<td>Rs 2,01,051/year</td>
<td>Rs 1,01,732/year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unloading time reduction</td>
<td>Route 1</td>
<td>3hr/day</td>
<td>1hr/day</td>
<td>1hr/day</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Route 2</td>
<td>2hr/day</td>
<td>1hr/day</td>
<td>1hr/day</td>
<td></td>
</tr>
</tbody>
</table>

- Companies must pay attention to their inbound supply chain operations and realize that there is a lot of money that can be saved by adopting best supply chain practices.
- The improvement programs in the supply chain system must focus on attaining a win-win situation to build strong relationships, so that not only the manufacturer but the suppliers also should get benefited.
- Information sharing and propagating the demand variability between the supply chain partners is required to attain customer satisfaction.
- Integration and focus on working towards a common goal is required between supply chain partners to achieve competitive advantage in today’s customer driven market.
- By streamlining the supply chain, a company can reduce inventory, improve time to market, compress cycle times, free up more cash, decrease costs and improve profitability.

REFERENCES