Implementation of Milkrun in an Automobile Manufacturing Industry

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Abstract— Current works speaks about implementation of lean logistic called Internal Plant-wide Milkrun at an automotive manufacturing industry, which provides material cyclically at the right time, in the right quantities of right parts, to the right place to the production at the point of use. Concepts like VSEM, VSED, PFEP, establishment of Supermarket, by defining supply cycle were analyzed and standard operating procedures were designed to make system work successful. The outcome of this work is that Milkrun has been successfully implemented by defining 2 hours frequency between 2 Plants at an automotive manufacturing industry; it showed significant improvements in delivery time to the internal customers which further reduced inventory level.

Keywords— Milkrun, VSM, VSD – VSE (Value stream Extended), PFEP (Plan for Every Part)

I. 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 consumer 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 at the right time at acceptable price and at the desired location.

Internal Milkrun is a method of cyclic material supply in order to provide material at the right time, in the right amount and quality, at the right place within the production area at the point of use. The standardized work for the milk runs with respect to capacity analysis, scheduling, mixed integer models, and operator assignments solved problems in an industrial area (1). The milk run concept is frequently applied in internal plant logistics to transport raw materials, finished goods, and waste between manufacturing and assembly Stations and the warehouses of the plant (2).By using the Just-in-Time system, planning and scheduling of every significant parts of the production have to be done effectively and efficiently. Supply procurement is one of the most important parts in the production system and has to be planned and scheduled to support the needs of the production line (3). Value Stream Mapping (VSM) technique, developed within the lean production paradigm, and was presented as an innovative graphic technique to help practitioners redesign production systems (4). IE techniques such as VSM, VSD, simulation and the proper scheduling results shown a significant improvement in terms of cost reduction and decrease in inventory (5).

In this manufacturing industry; there are 2 internal customers manufacturing single cylinder Pump and Multi cylinder Pump at Plant 1 of diesel Engines. Both these Pump assemblies take place in the same building. Component (Elements & Delivery Valve) required for Pump assembly are manufactured at Plant 2 which is 500 meter away (inside company).

The objective of this paper work speaks about implementation of Milkrun between theses 2 Plants, which further reduced inventories of Elements and DV at Pump assembly area, which were supplied previously in a improper manner independent of material requirement, also to reduce delivering time of these Elements & DV to Plant 1 by defining standard operating procedures for the entire Milkrun activity

II. METHODOLOGY

To meet the main aim and the specific objectives of the study, methodology adopted are as follows:

1. Study of existing transportation mode of Plant wide supply.
2. Overall data from supplier to customer collected by the use of Value stream Mapping (VSM) – Value Stream Extended (VSE) of existing condition and documented the same using VISIO software
3. Value Stream Design (VSD) – Value Stream Extended (VSE) done by considering the company's guidelines and documented by using VISIO software
4. Setting up the frequency for Milkrun based on demand of Pump assembly at plant 1.
5. Setting up the PFEP-Plan for Every Part.
6. Defining Standard operating procedures for each of the operations throughout the Milkrun activity.

III. DATA COLLECTION

A. Time study was conducted on Milkrun activity and frequency with which material transportation happening to Plant 1 from Plant 2 observed that there is high variability with respect to activities causing failures in delivering the components from Plant 2 to Plant 1 at right time.

B. Route fallowed by both customers (PE & PF) are different even though supplier is at the same distance same Plant.

C. Customer information is given by drawing Pareto graph showing Pumps with high demand. Initially we planned for those parts which are of high demand shown in Figure 1.

D.

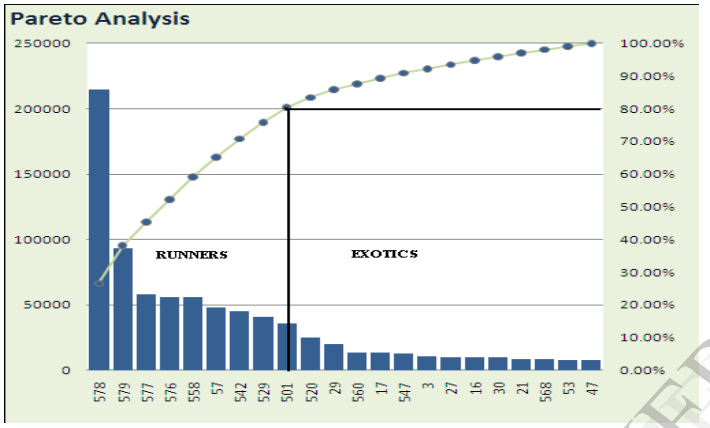

Figure 1: Pareto analysis

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E. About the supplier; Due to improper visualization at Element section of Plant 2 (shown some other major causes for delay in delivery time), Milk runner spends the valuable time in sorting out the components that are needed, in this place Milk runner's service time increased because of, Elements required for Plant 1 are inspected twice which is high NVA identified shown in VSE-VSM –PE. Some of the other causes are shown by drawing cause & effect diagram in Figure 2.

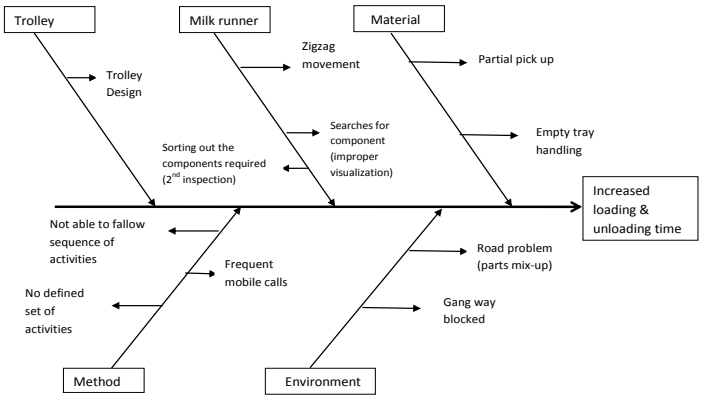


Figure 2: Cause and Effect diagram

F. Weight parameters

Materials which are transported using some material handling equipment and there weights are identified to find out optimal use of trolley avoiding over utilization of the trolley.

Table 1: Kanban calculation for FMG Lines

Material	Kgs
Empty bins	1
Empty trays for Element	0.3
Empty trays for DV	0.15
Weight of Element / Pcs (PE)	0.055 to 0.1
Weight of Element / Pcs (PF)	0.055 to 0.2
Weight of DV / Pcs (PE)	0.015 to 0.055
Weight of DV / Pcs (PE)	0.015 to 0.075
Milkrun Vehicle capacity max.	800

G. Value Stream Mapping -VSE

As the material transportation was happening separately for both PE & PF Pumps VSM is captured for both the Pumps separately, from the available data current state value stream map is drawn and is as shown in the Figure 3, Figure 4 which gave a snapshot of overall process.

Interpretations from PE customers:

- Total process time: 40 min
- Total waiting time and unwanted activities: 35 min
- Total lead time: 95 min
- Total distance travelled: 560 mts
- Inventory 2 shift advance

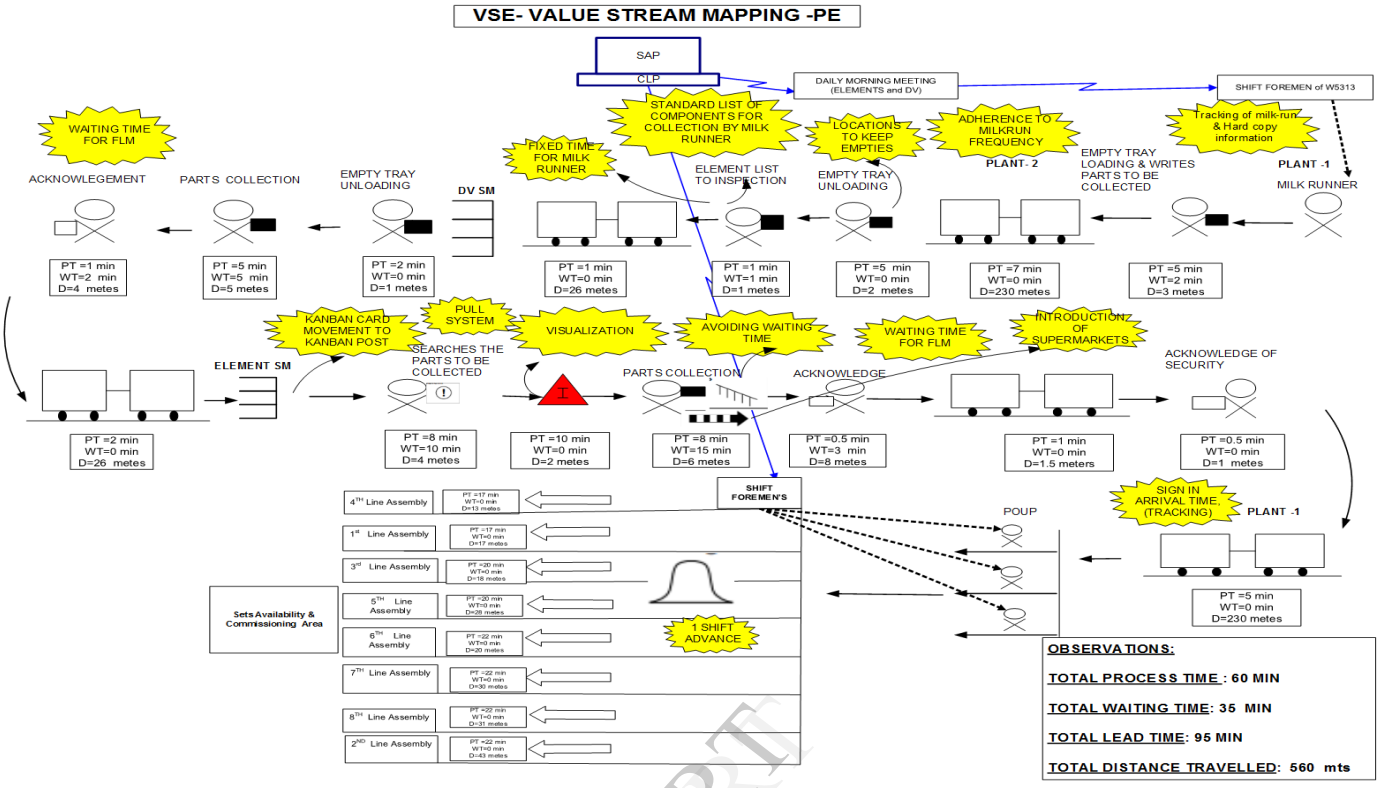
Interpretations from PF customers:

- Total process time: 65 min
- Total waiting time and unwanted activities: 25 min
- Total lead time: 90 min
- Total coverage distance: 396 mts
- Inventory 2 day advance

Some of the common and important NVA identified were:

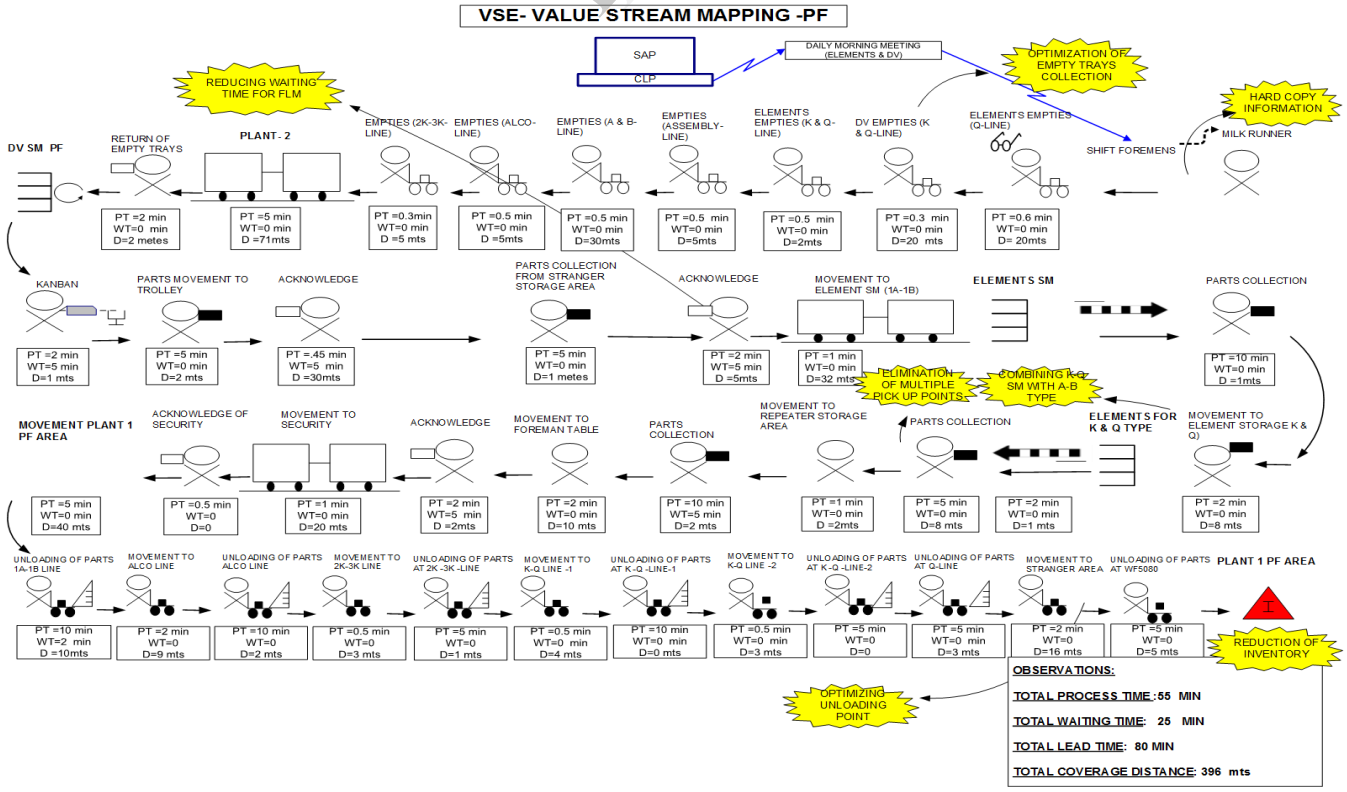
1. Waiting time to collect the information about parts to be collected in Plant2.
2. Empty trays were not centralized properly causing higher time to collect empty trays.
3. Increased waiting time to take signature from line FLMs on the 'movement slip' after collection of parts from Plant 2.
4. Unwanted activities by milk runner during entire process. (No tracking of Milk runner).

5. Milk runner used to collect parts in advance which



lead in increase of inventory of collected parts at Plant 1.

Figure 3: Schematic representation of current state



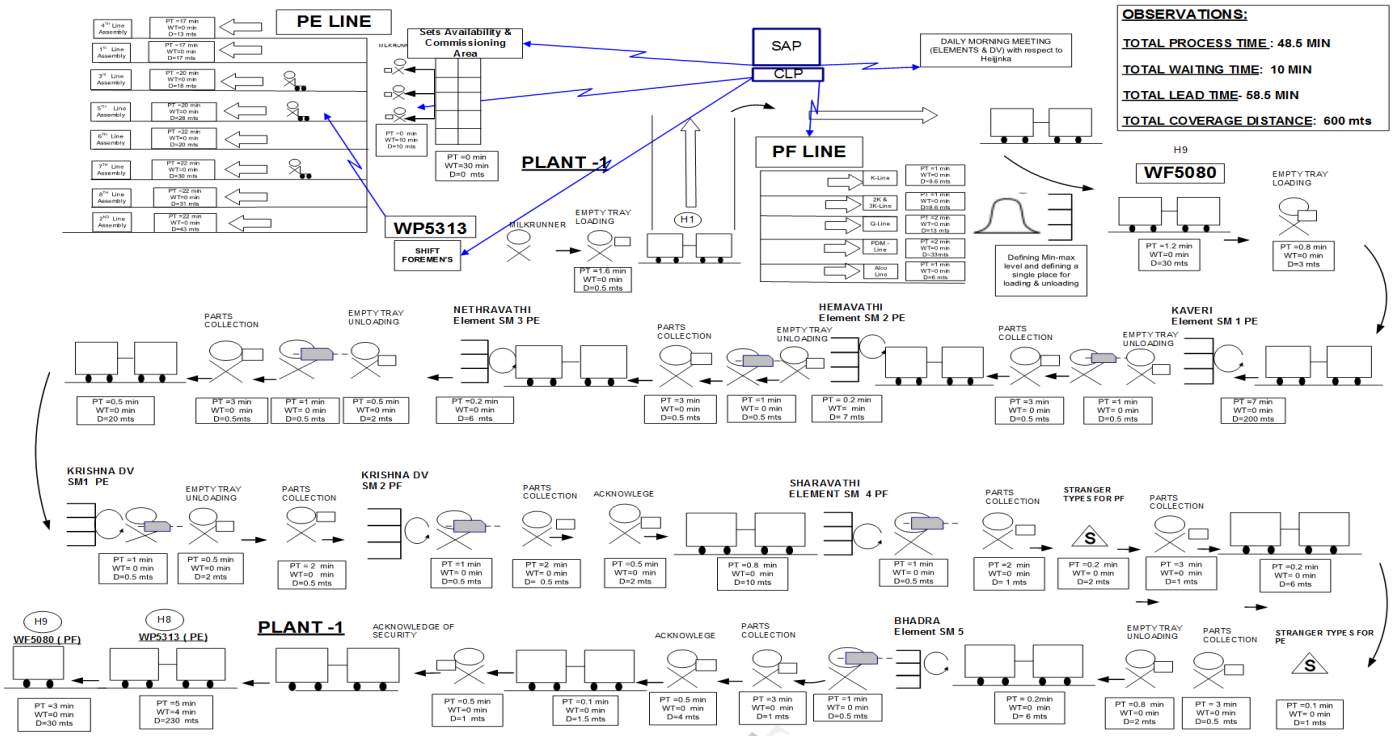


Figure 4: Schematic representation of current state PF-VSM

Figure 4: Schematic representation of VSD

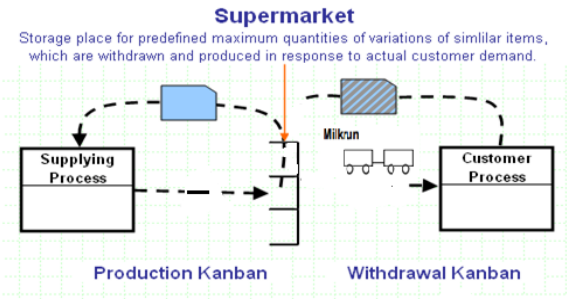
IV PROBLEM SOLVING

A Value Stream Extended-VSE

After mapping current state the next step is to improve the present situation by identifying all the problems and to achieve a future state that proves most optimal state. Also fulfils all lean manufacturing characteristics. A future state map identifies improvement to be made to the value stream that will shorten the overall lead time, improves overall equipment efficiency, inventory reduction and reduced improve information flows. Future state mapping is as shown Figure 4.

B Supermarkets

Introduction of Super markets at Plant 2-(Solved visualization problem & sorting out problem) reduced waiting time and delivering time. Some visualization deployed to avoid Milk runners in finding of parts required, Supermarkets helped in production of Plant 2/consumption based as well ease the work of Milk runner.



C. Time and method analysis

To set perfect timings for each activity from Milkrun

Start point to end Standard timings defined using equation

$$ST = NT + NT \times allowance$$

$$= NT (1 + allowance)$$

Where,

ST = Standard Time: the time in which you expect workers to complete an operation.

NT= Normal Time: time required to complete an operation for a given operator
Allowance = Allowance factor for personal time, fatigue, and delays

Example,
As defined in Standard work sheet (StaB-Companies standard) for an activity, Collecting required amount of parts at an average of 5 part numbers from Supermarket-

ST = NT + (NT x Allowance)
= 1.5min + (1.5 min x 0.15)
= 1.5 min + 0.525 min
= 1.725 minutes.

As in Example shown we defined 39 activities for Milk runner; using equation Standard time for all activities were defined

D. Defining supply cycle

For any cyclic material transportation defining the frequency is the main very important

- Total cycle time taken to complete one full tour by the milk run is defined as 1 hour.
- For 1 hour it takes 2 Sets trolley to get ready & so for 2 hour around 4 sets trolley gets ready which consist of 500 pumps to be assembled in Plant 1. For most optimal use of Milkrun vehicle we have defined that the Milk Run vehicle should bring components required for these 4 sets trolley (500 Pumps) in a cycle.
- Considering all the breaks for milk runner (Lunch, tea, shift start allowance) while defining frequency.
- Allowance of ±10mins.for overall activities.
- After analysis numbers of cycles were increased to 12 trips from 9 trips in a day.
- According to company standards Milk run must possess 300 kgs not more than 800 kgs so using demand from Plant1, load factor were set.
  - 300< X <800 kgs
  - X is qty supplied per cycle

F. Proposed layout

After considering 3 proposed layouts we have chosen the best among them, which delivers the material for both the customers in a single run /cycle shown in below picture.

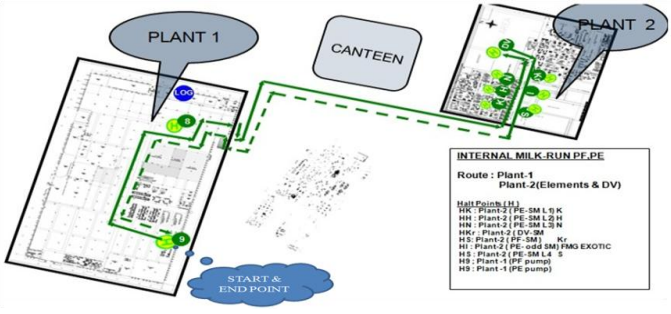


Figure 5: Proposed route layout

V RESULTS & CONCLUSION

1. The cycle (delivery) time before = 75 min (PE) + 70 min (PF) =145 min, referring VSEM. The cycle time after = 50 min (PE & PF) referring VSED.

$$\frac{DIFFERENCE\ IN\ CYCLE\ TIME}{CYCLE\ TIME\ FOR\ OLD\ MILK\ RUNS} = \frac{95\ minutes}{145\ minutes}$$

We therefore find out the reduction in cycle time is approximately 65.55%.

2. Implementation of Milk run, a cyclic transportation of material based on the demand data is adjusted to frequency of once in two hours and also by increasing number of cycles from 10 to 12 cycles of supply in a day got the benefits shown below:

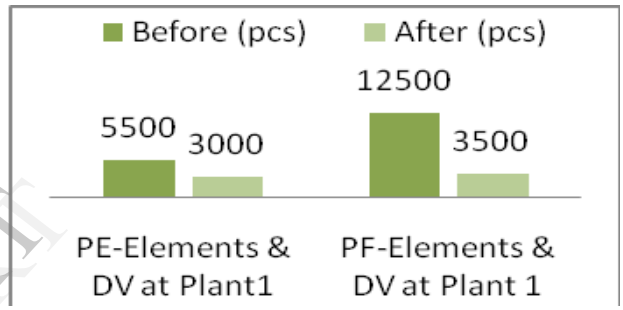


Figure 5: Inventory reduction

V CONCLUSION

Milkrun a lean logistics, helped in cyclic material transportation based on only requirements to point of user (customers) helped customers in getting right parts in right amount based on JIT. Milkrun logistics has been planned to improve loading rates at possible levels and reduce the number of trucks and travel distances. As a result, it is an excellent transport method. This tool helped in reduction of inventories. Using Heijunka, PFEP, demand data base, frequency of Milkrun activity are set for once in 2 hours per day helped reliable supply of Elements and DV to PE & PF customers.

SUGGESTIONS FOR FUTURE WORK

- As of now Milk run activity is driven by a requirement slip called 'movement slip' has to further improved to transport Kanban to avoid maximum human interventions.
- Further optimization with 'transport Kanban' instead of 'movement slip' can reduce manpower by 10 % by multitasking during idle time.
- Supermarket concept at supplier stage can reduce further runners as well as exotics inventory in the value stream at Plant 2.

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