Improving In-plant Logistics by Process Reengineering: Case Study

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Abstract

This paper documents the experience of redesigning in-plant logistics operations of a large petrochemical complex in India. The complex under reference is expected to have a traffic volume of one truck per one minute by 2005.

The existing systems and procedures to receive and inspect a truck, load material, and complete commercial formalities are designed with a target truck turnaround time of 82 minutes. However, in reality the actual truck turnaround time is significantly higher than the target turnaround time.

The plant is located in a growing industrial area. Inordinate delay in truck turnaround time is a major demotivating factor for the truck companies to place their trucks with this complex. Consequently, there is a significant variation between the planned and actual dispatch of finished goods.

This investigation systematically analyzes the reasons for significant departure in the truck turnaround time. A truck driver survey is used to identify and prioritize areas of delay.

As a consequence of this analysis, it is argued that deployment of additional resources, optimizing the activity processing time, sub-contracting some of the activities and extensive automation of the process would only marginally improve the performance of the turnaround time.

In order to improve the turnaround time substantially, there is a need to redefine work, and fundamentally change the underlying process. Accordingly, several initiatives are identified to ensure dramatic reduction in the truck turnaround time.

1. The Plant, Location, and Products

Large Petrochemical Complex (LPC), was characterised by aggressive growth, (revenue and profitability), economies of scale, dominant production capacity, proven financial and operational performance, and excellent relationship with shareholders. See Table 1 for a summary of the financial performance of LPC. The integrated manufacturing facility of LPC, processing a variety of products, broadly categorised as polymers and polyesters, was located in the western part of India.

The LPC plant location had its own advantages and disadvantages related to logistics. It had easy access to sea route, but trucks were not easily available. The major transport services

were provided and operated from Bombay with a small office at the plant site. Thus, co-ordination and planning between plant, Bombay and the transport representative at the plant site was a key requirement for effective material movement.

The sales tax advantage applicable to the area had attracted large industrial houses to set up their manufacturing and processing facilities around the LPC plant. This led to greater demand for trucks to move material. The end customers (both small and medium) of LPC were scattered all over the country. To get the sales tax advantage LPC had to use the plant location as a base either for direct invoicing or stock transfer (minimum 40% of the volume).

The logistics function involved a large number of agencies within and outside LPC, viz. production, quality control, bagging, warehouse, excise, commercial, load office, weigh-bridge, security, Market Operations Group (MOG) at Bombay and at plant location, business planning, transport contractors (at Bombay and at plant location) and transport representatives. Roughly two thirds of the logistics related workforce of LPC was on contract (Table 4).

2. Systems, Procedures, and Practices

Production Planning: Based on the market forecast and the existing stock at various locations and regions, and considering business prospects and other commercial projections, a monthly product wise production plan was finalised at Bombay and communicated to the plant. The manufacturing department translated this into weekly and daily production plans. There were however, significant variations between what was originally planned and the actual production (Table 3).

Subject to technical quality clearance, the material produced was stored in a silo for subsequent bagging. The major interface between production and in-plant logistics was the bagging operation, which was under the supervision of Production. The bagging plant was highly automated and bagged material in 25 Kg. standard bag size. Along with bagging, the lot number, grade, bag-number, and date were printed for subsequent product, grade, and lot identification. Manual registers kept track of material bagged. Automatic weighment counters cross checked the quantities bagged. The most important function of the bagging section, from the logistics perspective, was related to material accounting. This was the first location in the plant where weight based proper material accounting was possible.

After bagging, material equivalent to 1 MT was palletised and moved on to an appropriate location, which was determined by the bagging supervisor. The computer stock was updated at the end of the shift on warehouse location occupancy and stock quantity. The forklift operators, who moved material from bagging plant to storage, were under contract to LPC.

Marketing Interface: LPC-Marketing set up was at Bombay. The marketing executives usually reported to their respective business heads. Based on the market dynamics, despatch orders were placed on plant location for material delivery. The Bombay office electronically communicated the set of Despatch Orders (DO) that were to be processed on any day to plant and a backup confirmation copy was sent by post. This document was initiated activities related to material despatch from LPC complex. The DO copy was received by Marketing Operations Group (MOG) at plant for further processing. Meanwhile, marketing informed the truck operator's representative at Bombay for placement of trucks in the plant. The truck operators at Bombay, in turn, informed their counterparts at the plant for trucks

placement. This activity happened in parallel to the transmission of DOs. The MOG at LPC also contacted the truck representatives at plant location for deployment of trucks.

Documentation: After reporting for loading the trucks were parked in LPC complex for preparation of entry ticket. The transport representative periodically on arrival of 2 or 3 trucks visited the despatch office (MOG location) to verify whether there was any Despatch Order (DO) to be executed by his company. If yes, he would get a copy of the DO from MOG and prepare the Transport Authority Letter (TAL), a legal document required for material transport. The truck driver along with the DO and TAL presented the truck for security pre-inspection. The pre-inspection (details included in Table 10) was executed by security in batches of approximately five trucks. On security clearance, the trucks were allowed to go inside the LPC manufacturing complex with an entry ticket, a prime document that tracks the truck movement inside the complex.

The entry ticket had a unique number representing the date and the serial number of the truck for the day. The entry ticket had information on the product, customer identification, customer location, and data on vehicle identification. The entry ticket stayed with the vehicle until the truck left the LPC complex. While some of the data elements related to the entry ticket was captured online in the existing computer network, most of the data elements were entered manually.

After generation of the entry ticket, a vehicle was allowed to pass through security gate and was inspected at the check post for safety features and possible additional material, which might distort the weight of the empty truck. On clearance by Security at the check post, the vehicle passed through the weighbridge where initial weight of the truck had been recorded.

After the weighbridge entry operation, the truck along with the DO reached the warehouse of the appropriate product group. The truck driver produced the entry ticket, along with DO in the despatch office. Blank computer generated pick-up notes were provided to the supervisor in charge of warehouse operations to initiate and monitor material loading. A group of contract workers and forklift operators got ready to transfer material from a particular location in the warehouse to the assigned truck. While loading was in progress documentation related to lot number, grade and serial number of the bags were entered in the pick-up note. On completion of loading operation, information on bag-wise quantity loaded in the truck was sent to the despatch office in the form of filled-in pick-up slip for invoice preparation, material accounting, stock updating and other legal formalities. Meanwhile, the truck moved out of the loading bay and was attended to for related activities like tarpaulin tying.

Once the despatch office in the warehouse received the loading information related to bags, an invoice was generated. Technically, this was to be prepared online. But, in reality, this invoice generation was a batch process. The invoice generation process waited until 4 or 5 trucks were loaded and the related information on pick-up notes was received. Subsequently, the pick-up note data entry was made based on which the invoices and excise gate passes were generated. The truck driver collected this invoice and moved to the out-weighbridge. Stock and inventory were updated at the end of the day.

When the truck left the warehouse area it was expected to report to the out-weighbridge as early as possible. The truck driver again reproduced his entry ticket at the weighbridge, the truck got weighed, and the material weight (as a difference of two weighbridge recordings) was computed (manually) by the security guard. If the difference suggested a potential problem area, further probing and checking were conducted by security. Otherwise, the truck

was allowed to pass the out- weighbridge (See a descriptive picture for additional information and clarity).

The Truck Drivers: The following is a set of eight occasions when the truck driver not only needed to interact with an agency in LPC, but also awaited either for a document generation or updating.

- Reporting to MOG at the plant site via truck operators' representative
- Presentation of the truck for security verification before entry ticket generation
- Presentation of the truck for security verification (check- post) after entry ticket generation
- Weighbridge-in entry
- Arrival of the truck at the warehouse for material loading.
- Preparations of the truck like tarpaulin tying etc. after loading.
- Presentation of the truck on the return path at the weighbridge out gate.
- Presentation of documents before exit from LPC.

3. Performance Measures

Truck Turnaround Time: The In-plant logistics system that was practised at LPC was influenced by the organisation of facilities like security gate, weighbridge, layout of loading bay and warehouse occupancy, and procedures followed within LPC. The understanding and co-operation of truck operators and contractors in doing business with LPC also played an important role in adopting and streamlining this process. The result of all these components was the time a truck spent in the system (to be received, loaded and moved out of the system). This single measure not only evaluated the total performance of in-plant logistics function at LPC but also provided an opportunity to quantify performance improvement as and when they were planned and implemented. In order to appreciate this measurement, LPC collected data on truck arrival and departure statistics for a span of 45 days and conducted some analysis. There was no specific reason for selecting this time period and this period was considered to be representative. This data was organised as follows: Entry gate time to warehouse reporting time; Loading time at the warehouse; Exit gate time from entry gate reporting time.

In addition, data was classified as the total cycle time and non-loading time to reflect the time spent by the truck in the system after loading (Table 6, 6A and 6B).

Truck Drivers Survey: In order to identify possible changes in the system from the truck drivers' point of view a survey was conducted by LPC. Two sets of questionnaires were administered to the truck drivers. One questionnaire was to find out the general impression of the truck drivers related to their experience within LPC plant. This feedback explored the actual duration a truck driver had been interacting with LPC, what was his assessment of the total transit time, where does he think that the delay occurred etc. (Table 8). The second questionnaire was primarily aimed at truck drivers who had experienced some delay in transacting business at LPC and it specifically required them to prioritise in their opinion, as in which location the delay occurred (Table 9).

Security and Logistics Interface: In the LPC complex, the role of security was comprehensive. Their responsibility spanned from material accounting, protection of the complex from fire and accidents, regular supervisory control on pilferage, control of man and material movement and traffic management. Roughly two thirds of the security force

was on contract. The orientation and approach by security staff in LPC, in dealing with truck operators was more biased towards control and prevention of material pilferage rather than traffic management.

4. Analysis and Diagnosis

Observation 1

The loading operation is not the major contributor for truck turnaround time. The other related activities are acting as a drag on the system.

- The systems and procedures are designed for a truck turnaround time of 82 minutes (Table 7). But in reality the average turnaround time is 165, which is almost double the target time.

- The loading operations take 26 minutes as against a target time of 20 minutes. The time required to reach the warehouse is 44 minutes as against a planned duration of 10 minutes.

Observation 2

The bottleneck activity is security and vehicle check.

- Table 8 and 9 (based on the truck driver survey) indicate that major delays occur in Security Gate No. 2, followed by vehicle check area.

Observation 3

There is a mismatch in the portfolio of activities and the time allotted for these activities.

- The design time for security check is 4 minutes. From Table 7 and10, the number of activities and their details imply that the time required for security (vehicle check) is lot more than what is proposed.

Observation 4

Work is fragmented; there is no consumer focus; several non-value added activities; too many documents; cumbersome process (Table 5, Table 11).

- The truck driver has to stop at 8 locations before leaving the complex
- He has to interact with six different departments before completing his work
- Nine documents need to be generated before a truck leaves the system. Every document need the cooperation of several departments inside the complex
- No one in the system is bothered about the truck turnaround time. Every department is internally focussed.

Observation 5

Inability of the company to execute the dispatch plan. Poor performance arising out of complicated processes. Secondary effect leading to blocking of working capital (advanced excise duty) with government agencies.

- The planned and actual dispatches vary. The maximum deviation can be 2/3rd and the minimum is 10%.

Observation 6

Myopic optimization on resources. Stretching ordinary resources to execute complex jobs.

- Security is on contract. They perform a large set of activities. MOG is incharge of letting a truck to come in. 2/3rd of the employees are on contract. The key document entry ticket is made in several small segments.

Observation 7

The processes are poorly managed. At best a set of activities are executed. There is no senior management involvement nor consumer based monitoring systems in place.

- Poor dispatch rate, extended working hours, long delays in truck turnaround time, inappropriate job design and conservative time estimate.

Observation 8

The process is waiting to be redesigned.

- In a comparable size plant, elsewhere the truck stopped only once inside the plant for loading operation.

Observation 9

Duplication in work, convoluted information sharing and processes leading to poor performance.

- The Bombay marketing coordinates material movement with plant. Truck representatives need to reach plant MOG for load confirmation. Bombay marketing communicates to truck company in Bombay. They in turn communicate with their representatives at plant.

Observation 10

Revised process need to have multiple objectives and ensure efficiency in all of them.

- Volumes are expected to grow dramatically (1 truck a minute), plant safety is important. Truck drivers are reluctant to visit the plant in view of large turnaround time, consumers are focussed on lower cost of transportation

Observation 11

Excellent situation and opportunity for automation.

- Multiple departments, large volume, several documents, need to comply with regulations, dispersed location of activities, warehouse management etc.

5. Approaches and alternatives

Based on the above set of observations, it is possible to generate several alternatives by which the turnaround time can be improved. We discuss some of these options.

1. **Automation:** A simple and often sought out procedure is seamlessly automate the activities. This would ensure data consistency and a one-time reduction in performance measure. But, dramatic improvement would not be feasible. The truck driver still need to stop at 8 locations and complete his activity in several small segments.

2. **Augment the resources:** The load on the system today is 620 vehicles (Table 2) and a 50% additional increase during peak time. 30 vehicles per hour are expected to arrive over a period of 20 hours. This would mean a truck arrival every two minutes. With a weighbridge operation 6 minutes (by design), there is bound to be a queue. There is a clear case for additional weighbidges, security gates and loading area operations.

   Obviously, such additional resources would reduce the waiting time by increasing the throughput. But, because of the way in which the entire process is organized, the resources (additional facilities) are not well utilized. Needless to emphasis the (needed) rate of augmentation of resources and hence investment would be far higher with the growth in traffic. Also, the bottleneck operation would shift to some other area.

3. **Outsourcing arrangements:** Under this scheme, the truck checking and related activities can either be outsourced or delegated to the vendors, so that the delay in the plant on account of this activity can be eliminated. Alternatively, a buffer area may be created to check the safety aspects of the trucks. Trucks, which are cleared, may be directly allowed to report to the weighbridge with an entry ticket. Alternatively, even the weighbridge (in) operation can be combined with safety check of trucks. Obviously, this arrangement would segment the waiting time in two parts with no real improvement on the overall time. Outsourcing and self-certification would need mindset changes with the senior management of the complex and vendor community. The plant may have to propose a higher compensation for such a truck to sustain the relationship.

4. **Process simplification:** The gate entry process, loading operations and invoice generation may be simplified to reduce the waiting time at respective locations. In the best case it would bring marginal improvements in segments of processing time and may need significant investments.

5. **Process reengineering:** We advocate an approach, which requires fundamental changes, and when implemented would result in dramatic changes on the performance measures [1].

It is important to observe that the purpose of the current process is material accounting based on the difference between weighbridge in and weighbridge out operation, to record and check the weight of the material loaded on the truck.

We observe that this is a passive measurement. Actually, the plant loads material on a FIFO basis to the truck. The pack size is uniform and is 25 kgs. The bags are identifiable by batch number and a serial number. An appropriate electronic counter in the loading area would provide the weight of the material loaded. Such an arrangement would eliminate the need for weighbridge operations. This arrangement should be supported by automated (bar code) identification of bags, conveyerised material handling at the warehouse, frequent material accounting in the warehouse. The back office work like generation of invoices etc. would be triggered by truck loading information and the documents would be handed over to the driver at the exit gate.

In the revised scheme of arrangement, the security check of trucks would be outsourced, truck would be monitored and identified within the plant by electronic devices and the entry ticket would be generated by an automation process at the entry point, travel electronically to the warehouse, updated accordingly on loading, move to commercial office electronically and would be physically available at the exit gate.

Such a process would ensure minimum turnaround time, maximum of one stoppage point for the truck, almost no interaction by the truck driver with any of the departments in the plant and seamless data and process integration. The resources employed for such a process would be the lowest. Data accuracy would be 100%. Ability to adhere to FIFO and material accounting would be very easy.

The proposed model blends process reengineering, outsourcing, automation and simplification of work. It replaces conventional practices by an appropriate combination.

6. Conclusion

We have described a real life example related to in-plant logistics in the context of a large petrochemical complex in India. The process is now managed in bits and pieces with no information coordination by a multiple of agencies inside the plant. Consequently, the truck turnaround time realized is about 3 times the designed target time. A simple survey on truck drivers was used to identify departments inside the petrochemical complex which are responsible for significant delay.

Several solution procedures like automation including computerization, deployment of additional resources, simplification of processes, reduction of activities were considered with a view to reduce the truck turnaround time to acceptable levels. However, such changes were not recommended in the final analysis as they address only a segment of the processes. While such approaches would provide some reduction in the truck turnaround time, they would provide either little or no relief in the long run. Actually, the bottleneck operation or area would shift from one segment to the other.

We have proposed a solution based on operational needs and contextual information available in the system. The new approach fundamentally redefines work. It actually changes material accounting philosophy from passive to active mode. The revised process would ensure only one stop of the truck inside the plant for material loading. The new process is Information Technology enabled and is supported by appropriate outsourcing

arrangement. The implementation of this new procedure would need employee empowerment and change in the mindset of the senior management team.

The major contribution of this article is that it demonstrates how (fundamentally) redefining work can enhance process performance and resource productivity.

7. References

1. Michael Hammer, Reengineering Work: Don't Automate, Obliterate, Harvard Business Review, July-August 1990, pp. 104-112

2. N. Ravichandran (2002), Towards World Class In-plant Logistics: Hindustan Industries Limited, Indian Institute of Management, Ahmedabad Case, Prod-234

					*(Rs. in crores)**
	Year 5	**Year 4**	**Year 3**	**Year 2**	**Year 1**
Sales	7019	5345	4106	2953	2098
Operating Profit	1457	1064	881	575	487
Profit After Tax	1065	576	322	163	126
No. of employees	12500	11873	11836	11935	11666

**** One crore is 10 million***

Table 1 Key Financial Characteristics of LPC

Product	**# Trucks per day**	
	Average	**Peak**
1. Polymers		
Product 1	100	160
Product 2	162	243
Product 3	139	201
Packing Material	30	45
Waste	5	5
Total Polymers	436	654
2. Polyester		
Product 1	46	70
Product 2	73	125
Product 3	37	49
Packing Material	25	30
Waste	5	5
Total Polyester	186	279
Grand Total	**622**	**933**

Table 2 Traffic Load at Plant

Sample #	**Despatch Planned**		**Actual Despatch**		**% Actual V/s Planned**	
	Product 1	**Product 2**	**Product 1**	**Product 2**	**Product 1**	**Product 2**
1	1000	-	1125	-	112.5	-
2	500	333	387	225	77.0	67.57
3	900	108	946	90	94.0	83.34
4	700	350	504	279	72.0	79.71
5	700	500	585.5	486	83.6	97.20
6	700	600	639	433	91.3	72.17
7	600	550	405	467	67.5	84.91
8	900	500	354	570	39.3	114.00
9	600	500	198	251	33.0	50.20
Total	6600	3441	5043.5	2801	76.41	81.40

Table 3 Despatch Planning Statistics (Daily Sample)

Agency	Relation to LPC	Role in In-plant Logistics
MOG - at Bombay - at plant	Internal to LPC External to plant logistics External to plant logistics	Service receiver Influences the performance Co-ordination of despatch plan
Truck operators		
At Bombay At plant location In-plant Truck Drivers & Operators	External to LPC and IPL External to LPC and IPL External to IPL External to IPL	Service/Resource providers Resource co-ordinator Co-ordination of resources Significant role in response time
Load Office (Marketing representative)	External to IPL	Co-ordination of load planning and despatches
Security	External to IPL	Supervision of activities Ensuring safety of material and plant Document generation Truck movement and traffic control
Weighbridge operations	Internal to IPL	Traffic Management Managed by security Material Accounting verification
Loaders/Forklift operators	Internal to IPL (Externally sourced) Contractors	Material retrieval and loading operations
Despatch section	Internal to IPL	Generation of documents Material movement co-ordination
Parking plaza (proposed)	Internal to IPL	Truck waiting area

Table 4 Agencies Related to In-plant Logistics

	Document generated	Location	Agencies involved	Comments
1.	Generation of letter of Authority	Security Gate # 2 MOG	Driver MOG Transporter Representative	Adds to delay Legal (contract) requirement
2.	Delivery order	MOG	MOG - Bombay - Plant Transport	Essential basic document for despatch
3.	Entry ticket	Security Gate # 2	Security Truck drivers	Essential connecting document for material handling in the plant
4.	Material pick up note	Warehouse operations	Warehouse contract loaders	Operational document
5.	Invoice	Despatch section	Despatch office	Legal document Commercially needed
6.	Form 45A and other legal documents	Despatch section	Despatch office	Legal requirement
7.	Transporter's Receipt	Despatch section	Despatch office	Contractual requirement
8.	Transport contract	Despatch section	Driver Transporter + Despatch section	Contractual requirement
9.	Lorry Receipt	Gate # 3	Transporters Representative MOG	Contractual requirement

Table 5 List of Documents Generated

	Product 1	Product 2
AVG	164.18	154.42
Min	95.63	92.52
Max	511.89	331.19
Median	144.40	145.39

Table 6 Summary Statistics: Cycle Time Total Transit Time (minutes)

	Loading time	Other than warehouse time	Entry Gate to warehouse time
AVG	26.42	137.77	43.36
Min	11.44	77.12	15.89
Max	102.39	409.51	153.92
Median	21.71	126.26	38.76

Table 6A Additional Details for Product 1 (minutes)

	Loading time	Other than warehouse time	Entry Gate to warehouse time
AVG	26.26	128.16	38.36
Min	14.42	61.88	15.33
Max	59.49	314.76	121.36
Median	22.14	123.74	33.52

Table 6B Additional Details for Product 2 (minutes)

Activity	Time (Minutes)
1. Security related	
Gate entry	1
Security check	4
Weighbridge	2.5
Weighbridge out	2.5
Sub total	**10**
2. Warehouse related	
Loading operations	20
Documentation	10
Sub total	**30**
3. Internal Travel (Movement)	
Security Gate to weighbridge	2
Weighbridge to warehouse	6
Warehouse to weighbridge	6
Weighbridge to Gate out	3
Sub total	**17**
4. Other activities	
For Tarpaulin tying	20
Document checking by MOG	5
Sub total	**25**
Total cycle time	**82**

Table 7 Standard Cycle Time

Area → / Priority ↓	Gate #2	Vehicle Check	Parking lot	Weighbridge in	Loading Area	Load Office	Warehouse Office	Weighbridge out	Security Gate#3	Gate#3 MOG	Somewhere
1	64	1	0	0	13	0	7	3	0	0	7
2	17	28	2	14	16	0	10	1	2	0	5
3	10	12	4	28	8	0	16	13	0	46	2
4	2	7	4	9	4	1	21	32	12	0	0
5	0	3	0	0	1	0	7	9	17	2	7
6	0	0	0	0	0	0	0	0	0	0	0
Not Stated	2	44	85	44	43	94	34	37	64	47	74
Note: Priority frequency rating of delay by truck drivers.											

Table 8 Reasons for cycle time delay (Sample size = 95)

Area → / Priority ↓	Gate #2	Gate#2 Security	Vehicle Check	Parking lot	Weighbridge in	Loading Area	Load Office	Warehouse Office	Weighbridge out	Security Gate#3	Gate#3 MOG	Somewhere
1	0	35	4	1	0	5	1	4	2	0	0	8
2	2	18	12	1	14	4	0	10	0	1	0	2
3	4	3	2	2	17	9	0	10	10	0	0	2
4	2	2	4	0	6	5	1	11	18	3	2	4
5	0	1	3	0	0	1	0	2	5	18	17	8
6	0	0	0	0	0	0	0	0	0	0	0	0
Not Stated	51	0	34	55	22	35	57	22	24	37	40	25
Note: Prioritisation of delay locations by truck drivers whose trucks suffered long delay.												

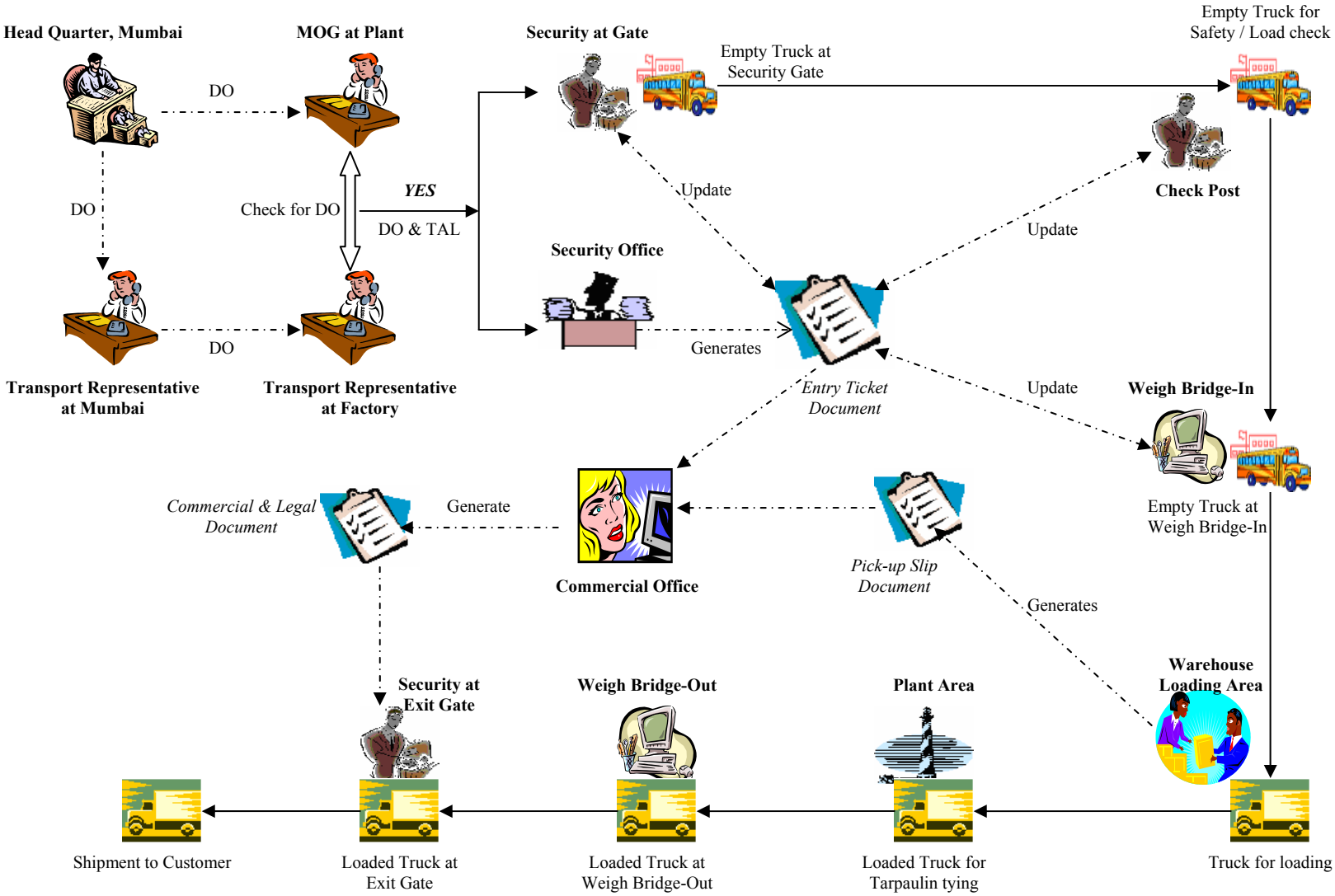
Table 9 Prioritisation of delay areas (Sample size = 59)

S.No.	Points
	Security Checks
1.	Cabin
2.	Engine Area
3.	Tyre Pressure
4.	Stepney - a) Available b) Tyre Pressure
5.	Check for extra weight/objectionable material
6.	Body search of driver & cleaner
7.	Spare diesel Tank level
	Safety Checks
1.	Wiring condition
2.	Head lights - working
3.	Signal lights - working
4.	Horn - working
5.	Wiper - working (Monsoon)
6.	Radiator cover
7.	Spark arrestor (operational area)
8.	Reflector
9.	Tyres condition
10.	Stepney condition
11.	Fire Extinguisher
12.	Self starting
13.	Brakes - working
14.	Hand brakes - working
15.	Handle/Valves/Master Valve box seals

Table 10 Security Check List item for Trucks

Documents Input	Activity	Agency	Document(s) Output
Market trend Order Book Stock at Warehouse	Planning at Bombay	Business heads	Product Mix decisions
Product Mix Plan	Production Scheduling	Production	Day to day Schedule
	Transfer to Production Silo	Production	Transfer register
	Transfer to Bagging Silo	Production	Transfer register
	Bagging Weighment label printing	Bagging Operations (sub contract)	
	Transfer to warehouse storage location	Contract Loading operations	Stock and location updation
Market Information	MOG Bombay DO generation	MOG-Bombay MOG-at plant	Despatch order
DO information	Communication to Transporter contractor	MOG-Bombay MOG-at plant	DO information
DO	Truck arrival at LPC complex	Truck Contractor Truck Representative	Letter of Authority
Letter of Authority DO	Registered for Loading	Security	-
	Pre Inspection for Loading	Security	-
DO Letter of Authority Pre Inspection Report	Generation of Entry Ticket	Security	Entry Ticket
	Checkpost clearance Load office clearance (only for liquids) Weighbridge in activity	Security	
Entry ticket	Arrival in loading bay, pick up slip, Loading, Tarpaulin Tying, invoice generation	Load office Contractors	Invoice
Entry ticket	Weighbridge out	Security	Entry Ticket
Entry ticket Invoice LR	Gate #3	Security	Invoice LR
	Exit		

Table 11 In-plant logistics operation process description



DO: Dispatch Order
TAL: Transport Authority Letter

Figure: Truck Movement Plan