SORTATION IN ECOMMERCE LOGISTICS IN INDIA: DESIGN PRINCIPLES FOR SCALABILITY & FLEXIBILITY

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Abstract: The choice of sorting automation needs to be based on trade-offs on cost economics, reliability and operational challenges. A greater degree of warehouse maturity is required to handle increasing throughputs. While generally the per-unit-cost of operation will reduce as warehouse move towards greater degree of mechanization and automation, costs are also dependent on local factors. At the same time, awareness of the tipping point is essential to maintain low cost of operations with the promised level of service. This becomes even more essential for low-margin sectors like ecommerce logistics and low-wages countries like India.

Given this, key questions that we need to answer on Sortation are:

1. Network design related:

1. What is the right sort philosophy – sort at source vs. sort at destination vs. hybrid?
2. What factors will govern the choice of sorting centre locations?

2. Asset strategy related:

- a. What is the asset cost-structure and accordingly the right technology for future sort requirements?
- b. How can we modularize the investment to handle peaks & scalability while factoring in practical constraints like land availability in urban areas?

The answer to above questions might change from industry to industry. As we scale beyond low-throughput sorters at Flipkart, we have analysed and answered some of these questions to build applicable strategies and business cases

Keywords: Sorting, Network, Technology

Introduction

A typical supply chain network comprises of warehousing, First Mile, MotherHub, Delivery Hub. Mother hub or the sortation centre is a critical node in supply chain given that all the shipments have to flow through sortation centres and has to orchestrate for SLAs and variations upstream and downstream. A critical portion of world-class supply chain design is network, process and automation design of sortation centres..... Lets look at the network design portion of the puzzle first

Network Design: The major portions of network design are sort philosophy and tailoring for various types of services.

Sort Philosophy: The choice of sorting philosophy is based on trade-offs on cost economics and need for flexibility. Table 1 analyses the pros & cons of both the philosophies.

1. Sort at Source

- Sort for the final destinations at source
- Involves lower touches and eases downstream operations

2. Sort at Destination

- Sort for the next node in the system
- Manages very high throughput and sort locations

Table 1. Sort Philosophies

Parameter	Sort at source	Sort at destination
Packaging Cost(material and manpower for bagging)	Lower due to bagging at one location	Higher due to duplication at both the nodes
Sorting Time	Will be longer with higher complexity of sorts and increased odds of choking at hubs	Dual packaging and handling will add to the sorting time but hub choking is minimized
Flexibility –Direct DH	Can deliver directly to high demand DHs	Rigid structure –Cannot deliver to high demand MHs
Error Rates	Higher due to very high complexity at one stage	Lower due to moderate range of sorts at both stages

Postal networks do sort at destination; Courier & express players adopt a mix of sort at destination and source as tabled below.

Table 2. Postal & CEP

	Shipments per day	Delivery Hubs	Sorting Centres	Sort Philosophy
Postal				
USPS	500m+docs and non-docs in the US	30,000+post offices (~150-250 post office per sorting centre)	200+ sorting centres	Sorting at 2 nodes Sort at source sorting centre for 150-200 destination sorting centre Sort at destination sorting centre for 150-250 post offices
India Post	16m+docs and non docs in India	1,50,000+ post offices	75-80 sorting centres	Sorting at 2 nodes Sort at source sorting centre for 75-80 destination sorting centres Sort at destination sorting centre for 1500-2000 post offices
CEP: Courier, express, Parcel				
UPS/FedEx	15m+ docs and non docs in the US	20,000+ delivery branches	Not disclosed	They adopt a dynamic sorting approach – sort next node in their network as well as a few key high demand lanes (“Jackpot lanes”) to balance their high throughput and sort requirements
DTDC	1 lakh non docs in India	300 delivery branches	15-30 sorting centres	They sort at the source sorting centre for the next sorting centre

Sort at destination becomes cheaper when the sort threshold for a particular technology or manual setup is reached. The same is highlighted in the following table. SAS favourable for retail...high volume, less destinations...

NDD, SDD → SAS gives speed

Table 3. Sort Destinations

No. of Destinations	80K per day BAU- (Designed for 1.5x, 1 Shift Operation for an inbound skew of 1.3 hourly lean:peak)	
	Sort @ Source CPS	Sort @ Destination CPS
250	5.7-6.2	6.8-7.3
500	5.7-6.2	6.9-7.3
750	6.5-7.1	7.8-8.5
1000	16.0-16.5	13.0-13.5

Learnings

Build flexibility in sorting solution to sort for optimal number of destinations at each mother-hub based on through-put requirement.

Table 4. Sort Tailoring

Options	Pros	Cons	Model
Local and Non Local	Reduction in number of sort destinations Enables faster local to local marketplace shipments	Process change required at the FC –segregating at the time of picking to avoid merge of local/non local orders	Segregation at Pickup Hubs and sent to the resp. MHs The FC MH will send unsorted shipments directly to the local MH enabled by local wave picking or dedicated local pickers
FA and NonFA	Enables faster local to local marketplace shipments	Loss of flexibility to reduce the skew of inbound No reduction in sort destinations	FC MH caters to FAload & sends unsorted shipments directly to the local MH MP MH caters to non FA load. Segregation at Pickup Hubs and sent to the resp. MHs

Learnings

Local vs. Non local tailoring is recommended if clubbing of requirements is not possible.→ geographical demand pattern

FA vs Non FA tailoring is governed solely by business needs & supply chain construct.

Facility Design Strategy

Sorting Technologies

A variety of sorting technologies are available to support different sort complexity and through-put requirement. Emerging market players have been late technology adopters –and are considering automation only now. This paper talks about the various factors and trade-offs in selecting sorting technologies. There

Maximize number of sorts at hub through dynamic bin allocation and managing in-bound waves.→ based on the load pattern of destinations

Sort Centre Tailoring for various types of services

Sorting requirements should be clubbed for scale benefits as well reducing the inbound skew of the FA and non FA shipments. But in scenarios where clubbing is not possible due to practical considerations like land availability etc., the following options are available.

is a wide range of options in sorting technologies. Some of the typical ones are:

Manual – manual segregation of shipments by scanning the shipment IDs using scanners/hand held devices.

Linear Sorter - pneumatic arm based lowthrough put primary sorting equipment used to sort items using dynamic sorting logic. As the name suggests, the destinations are arranged linearly, in a straight line.

Tilt tray Sorter - tray-based medium throughput system arranged as an endlessloop. Mostly used as baggage or shipping sorter.

Cross Belt Sorter - casket-based high throughput system arranged as an endlessloop. The system is well-suited for operations in areas with limited space or challenging layouts and high number of end-destination sorts.

Table 5 Compares the above technologies and their applicability.

Table 5. Sorting Technologies

Type	Manual	Linear Sorter	Tilt-Tray Sorter	Cross-Belt Sorter
Capex (mio INR)	~2	10	100	180
Throughput per hour	2K	3K	10K	15K
Optimum Sorts	10 per person	20	100	200
Area required (sq feet)	6 per bin (w/o aisle space)	4k	15k	25k
Products Handled	Cansupport multiple dimensions and product types	Mostly boxes, does not work too well with non-flat surfaces like poly bags	Wide range incl. apparel, small items in poly bags, CD's and small to large corrugated boxes	

Criteria to determine level of Automation

Cost Economics - Operations and staging area costs.

Factors that impact cost economics:

- Inbound window –Duration of inbound
- Inbound skew –Peak to average ratio of skew
- Number of sort destination
- Sortation SLA

Flexibility & Reliability -

- Ability to handle differing volumetric profile of products
- Accuracy
- Reliability (up-time)

Operational aspects - Other operational considerations

- Challenges of managing a large work-force
- Space constraints, especially in large cities

Figure 1. Sorting Technology Criteria

Figure 2. Sorting Technology Curve

The above graph demonstrates the CPS trend with increase in daily demands. While generally the per-unit cost of operation will reduce as warehouses move towards greater degree of mechanization and automation, costs are also dependent on local factors. At the same time, awareness of the tipping point is essential to maintain low cost of operation with the promised level of service.

Learnings

Overlaying other factors linear sorters becomes attractive from 50K daily through put onwards

Tilt tray sorters at 100K-250K have a range bound cost per shipment under different scenarios

In the 200K-400k throughput range Cross Belt sorters are better

Significant manpower reduction and higher reliability makes automation more attractive

The final mix for sorting technologies would be derived from the final network model

All of the above are for a 2 shift scenario.

Approaches for Peak Design Capacity

Sortation Centres need to handle the following 3 types of peaks and there are permanent & temporary capacity levers to address them

- Intra-day Peak
- Daily Average peak
- Sale month peak

Levers for Capacity Management

Permanent Capacity Management – Design for highest vs Design for intermediate peak

Temporary Capacity Management –

SLA Management -

- Set a higher delivery time promise during the peak season
- Take pre-bookings/ expand from single day to multiple day promotions

Manpower Planning -

- 3rd shift / Night shift operations using additional temporary staff
- Re-designing resourcing –overstaff for faster operations

Leveraging 3PL Sorting Centres –

- Enter into partnerships with 3PLs to utilize their spare capacity
- Typically difficult given matching of peaks during the period

Learnings

Designing for highest peak is 2-2.5 times more expensive than the designing for the second peak

Capacity planning for peak months (Sale) can leverage better SLAs, manpower planning and outsourcing

Solution Map

Data Basis

- Taken at network design throughput of ~100,000 shipments per day for a manual setup for 2 shifts (16 hrs)
- Labour cost linked with throughput (~90-95% variable)
- Security and rentals driven only by space (~100% fixed)
- Capital Expenditure driven only by installed capacity (~100% fixed)
- 2nd Peak taken to be 1.5-2 times average daily peak and highest peak 4-4.5 times the average daily peak

	chain construct.
Sorting Technologies	Overlaying other factors linear sorters becomes attractive from 50K daily through put onwards Tilt tray sorters at 100K-250K have a range bound cost per shipment under different scenarios In the 200K-400k throughput range Cross Belt sorters are better
Peak Design Capacity	Designing for highest peak is 2-2.5 times more expensive than the designing for the second peak Capacity planning for peak months (Sale) can leverage better SLAs, manpower planning and outsourcing

Conclusion

For a huge, diverse& growing country like India most of the decisions are based on optimization of resources. The answers the questions raised might change from industry to industry.

Network

Build flexibility to sort for optimal number of destinations at each mother-hub based on through-put requirement.

Maximize number of sorts at hub through dynamic bin allocation and managing in-bound waves.

Asset

The final mix for sorting technologies would be derived from the throughput requirement & final network model

Capacity planning for peak months (Sale) can leverage better SLAs, manpower planning and outsourcing

Sort Philosophy	Sort at destination becomes cheaper when the sort threshold for a particular technology or manual setup is reached Build flexibility in sorting solution to sort for optimal number of destinations at each mother-hub based on through-put requirement. Maximize number of sorts at hub through dynamic bin allocation and managing in-bound waves. → based on the load pattern of destinations
Sort Tailoring	Local vs. Non local tailoring is recommended if clubbing of requirements is not possible. → geographical demand pattern FA vs Non FA tailoring is governed solely by business needs & supply